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BY SURGEON-GENERAL SIR GEORGE MAKINS, K.C.M.G., C.B.

Consulting Surgeon British Expeditionary Force.

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which the final result was not actually assured. The results, however, fairly represent those seen at a certain stage of progress of such injuries, which may be approximately stated to be from the third to the twenty-eighth day, the period in which the initial dangers have been surmounted, and during which the most important after complications are likely to be met with.

The injuries to the intestinal canal have been purposely separated from the great chapter of perforating abdominal wounds, because injuries to the solid viscera and to the urinary bladder are of so vastly lesser importance from the prognostic point of view.

No attempt has been made to sharply separate wounds inflicted by bullets and shell fragments respectively, because at the stage at which the patients reached the general hospital no great difference in the severity of the course taken by the lesions appears to exist.

To illustrate the remarks on the general diagnosis of intestinal lesions, a section dealing with fifty-five cases in which there was reason to suspect visceral injury has been inserted previous to those dealing with the different segments of the alimentary canal.

Morbid Anatomy.

Before passing directly to the nature of the injuries to the intestinal tract, a word may be said with regard to the wounds of the body wall which accompany them. In a considerable proportion of the patients who survive to reach the general hospitals the external wounds are situated in the walls of the chest, the pelvis or the thigh; while in some instances the bullet may have traversed the upper extremity before entering the abdomen. The presence of the wounds in these positions is of special importance from the facts that the track may be undesirably elongated in the case of a fistula developing, and in the probable addition of a comminuted fracture of the ribs, pelvic or thigh bones, to complicate the course of the visceral lesion.

The characters of the wounds of the abdominal wall vary greatly. Fragments of shell may inflict very extensive lacerated wounds, such as that depicted in fig. 1, which may heal well when uncomplicated by visceral injury. For comparison fig. 2 is inserted where a similar but smaller wound was complicated by prolapse of a wounded loop of ileum, and where the free escape of intestinal contents interfered for a considerable period with the healing of the wound. Shell wounds of this class are usually single, and if penetrating they rarely reach the general hospitals. Much more common are ragged irregular openings of various dimensions by

To illustrate "A study of one hundred and eleven cases of Perforating Wounds of the Gastro-intestinal Canal," &c., by Surgeon-General Sir GEORGE MAKINS, K.C M.G., C.B.

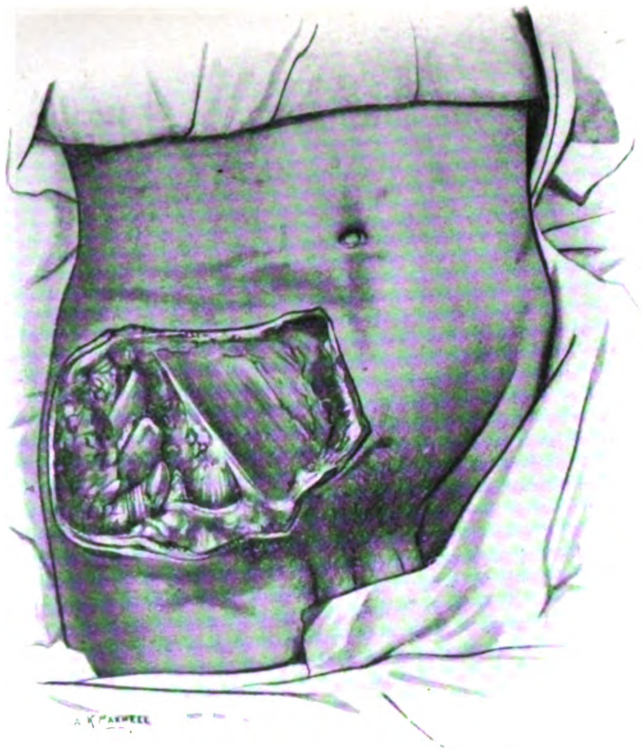

FIG. 1.—Extensive non-perforating lacerated wound of the abdominal wall, produced by a fragment of a high velocity shell.

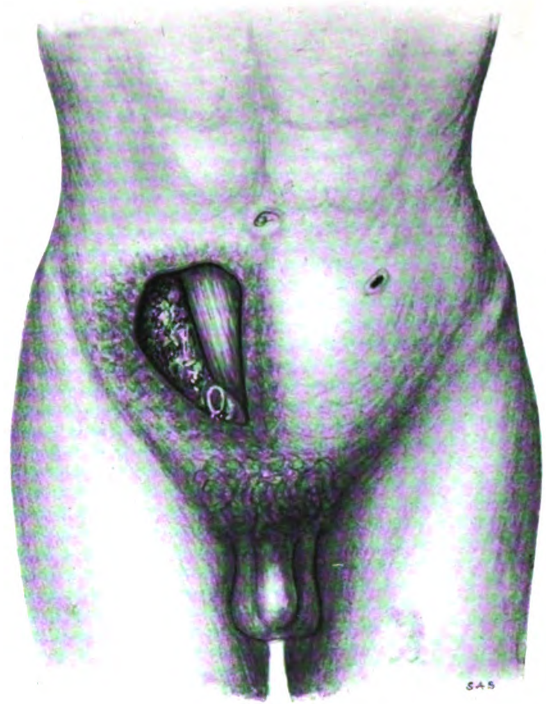

FIG. 2.—Lacerated wound of the abdominal wall. At the lower angle the wound involves the abdominal cavity and a wounded loop of small intestine is exposed, from the latter nearly the whole of the intestinal contents was discharged.

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FIG. 3.—Perforating bullet wounds of the small intestine of about three days standing, the process of contraction and repair has commenced. Viewed from the inner aspect the bowel exhibits openings not unlike those of a perforating enteric ulcer of the same date.

FIG. 4.—Lacerated wound of the small intestine caused by a fragment of shell of about three days standing. The margins of the opening stiffened by inflammatory infiltration hold the aperture widely open.

which fragments of shell have entered the trunk and very frequently are retained, lying either within the peritoneal cavity or in its walls. Shell wounds naturally possess a special danger in that the tracks are always infected from without, independently of possible contamination from a wounded viscus.

The bullet wounds vary much in character, a considerable number of type entry and exit wounds of mininal size are met with when soft parts only have been traversed by a bullet striking at right angles to its long axis. Large exit wounds of an "explosive" character are, however, far from uncommon and are most frequently met with in the loin. Such wounds result from the turning of the bullet during its passage through the body. Rarely an elongated wide entry slit is seen dependent on the bullet having primarily struck the body by its side; in such cases I have seen the bullet retained. If travelling at a high degree of velocity it would probably cause such injuries as to lead to a rapidly fatal issue, while the shape of the wounds produced would render them practically indistinguishable from injuries due to shell fragments. In some instances obliquely striking bullets produce long contour tracks involving the abdominal cavity only in a very limited portion of their extent, and the occurrence of these renders the diagnosis and treatment of contour wounds of the first importance. When the bullet has traversed the ribs or pelvis large explosive exit wounds are common.

It must be borne in mind that in cases of minimal entry wounds, it is quite possible that the opening may escape notice; and it has happened on more than one occasion that serious abdominal symptoms have only been explained after an extensive search for the external wound, and the latter has even only been discovered at a post-mortem examination.

Characters of the Gastric and Intestinal Injuries.—Wounds in the stomach or intestine may take the form of simple perforations, single when produced by lateral contact of the passing bullet, or double when the bullet has struck the gut sufficiently near the centre of its transverse axis. The single wounds are oval or gutter-like, the double circular; the wound of exit especially is usually occupied by protruding mucous membrane. Fig. 3 affords an excellent example.

Perforating wounds produced by fragments of shell or shrapnel case are more irregular and lacerated in character (fig. 4).[1]

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[1] We are indebted to the Editor of the *British Journal of Surgery* for the loan of figs. 3 and 4 illustrating this article, and for permission to copy fig. 1.

Single perforations of one coil of gut are of comparatively rare occurrence; they are naturally the least serious form of injury, and hence are seen more frequently at the general hospitals than the multiple perforations so often found at the field ambulances and casualty clearing stations.

Complete division of the whole lumen of the bowel, as would be supposed, occurs most frequently in the case of the comparatively fixed parts of the colon or small intestine.

In most cases in which perforation of the bowel has been effected, signs of bruising in the form of local ecchymosis are found on other coils of gut.

A serious complication is found in extensive ecchymosis or free extravasation of blood between the folds of the mesenteries, and these may be associated with widespread retroperitoneal hæmorrhages. The stiffening of the mesentery from extravasation between its layers may lead to technical difficulty in dealing with the injured gut, sometimes necessitating excision of the injured part in order to ensure a safe closure of the lumen. The clinical and diagnostic importance of the retroperitoneal hæmorrhages will be referred to later.

Of still greater importance are the intraperitoneal hæmorrhages. The hæmorrhage may originate from the mesenteric vessels, those of the omentum, from the solid viscera, especially the liver and the spleen, and more rarely from the parietal vessels, especially the branches of the iliacs. These hæmorrhages, like those in the pleural cavity, may become infected, and secondary abscesses result.

Extrusion of portions of the bowel or of the omentum is a common occurrence. The prolapse may occur from the aperture of exit, the gut following the course of the missile, or being carried together with it. Extrusion also occurs when a single aperture only exists, and affords an interesting piece of evidence of the "explosive" action of the entering missile, the prolapse being apparently a direct result of the increase of the intra-abdominal tension, due either to an actual sudden distension of the abdomen or to the pressure resulting from a sudden contraction of the muscles of the abdominal wall.

Retention of the bullet or shell fragment is a comparatively frequent occurrence in cases which survive to reach the base hospitals. Retention obviously points to a low velocity and consequent decrease in the immediate severity of the injury. The position of the foreign body can usually be roughly determined by an X-ray examination; but it is rarely found during the course of

an operation, and, what is still more striking, the missile is often extremely difficult to find at a post-mortem examination. In the majority of instances the difficulty, especially in the case of small pieces of shrapnel, depends simply on the length and intricacy of the wound track and the extensive blood extravasation; but when the bowel has been wounded, it is always possible that the foreign body may have been passed per anum. Several examples of this occurrence will be recorded below.

Results of Wounds of the Intestinal Canal.

While patients with abdominal wounds at the front die in a large proportion of the cases from hæmorrhage, the patients who survive to reach the base hospitals are more liable to death from inflammatory conditions. Thus of seventy deaths forty were due to peritonitis. Every death from a certain wound of the small intestine resulted from this cause, except two cases of duodenal wound and subsequent fistula who succumbed to general septic absorption and exhaustion. Seventy-three patients died from general septic absorption, twenty-one of whom had received wounds of the colon or rectum. Four patients died from secondary hæmorrhage, two with wounds of the stomach, one with a wound of the colon, and one with a wound of the rectum. Three patients died from fulminating gaseous cellulitis.

The form of peritonitis met with has practically always been the same. As is well known, gunshot perforations are usually not followed by primary free escape of intestinal contents, except in the form of gas. Hence primary effusion is rare, and secondary localized collections are only likely to be frequently met with in the colic wounds. Evidence of the paralysing effect of gunshot wounds on the musculature of the small intestine is offered by the absence of any primary escape of the fluid contents of the bowel, and even at the end of two days little extravasation has been seen at the base hospitals. Still more striking is the collection of hard fæces often seen in the lower segments of the large intestine stopping a few inches on the proximal side of the wound in the bowel, although here the effect of septic infection in lowering the peristaltic activity has also to be taken into account.

At the base hospitals the variation in the conditions met with in the peritoneal cavity in lesions of the small and large intestine respectively are very striking. Wounds of the small intestine are accompanied by a general peritonitis characterized by very widespread adhesions, little or no effusion, and very rarely by any

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localized collection of fluid. In such wounds of the large intestine as reach the base hospitals, a more or less localized peritonitis is much more common, a portion of the peritoneal cavity escaping the infection, and localized fæcal abscesses are frequent. Local reaction on the part of the peritoneum appears to be more pronounced to the escape of the more highly septic contents of the large intestine, and the formation of firm protective adhesions is consequently more rapid and effective. The escape of the peritoneum from infection is naturally most marked in those instances in which the wound of the bowel is retroperitoneal, but as I have pointed out before both in civil and military practice, wounds of the uncovered portion of the colon are nevertheless the more unsatisfactory form. Localization of the extravasated contents cannot take place so readily in the retroperitoneal tissue as in the peritoneal cavity, and consequently infection travels locally and general infection is severe. The statistics already quoted fully bear out these statements, since while all but two of the deaths from wound of the small intestine died from peritonitis, more than half of the cases of wounds of the colon died from general septic poisoning, a marked feature in many instances being a septic broncho-pneumonia.

Mention will be made below to a rare course of extension of abscesses secondary to wounds of the bowel observed in three cases in which the occasioning missile eventually lacerated and lodged in the muscles of the right iliac fossa. In each of these the abscess and intestinal contents followed the route taken by an ordinary tuberculous psoas abscess, in two cases reaching the thigh, and in a third the external malleolus of the ankle.

Reference to the subjoined table prepared by Lieutenant Henry is of considerable interest from several points of view. The thirty-four cases included represent the abdominal injuries met with amongst two hundred post-mortem examinations made at No. 13 General Hospital at Boulogne.

It will be first of all noted that injuries to the intestine do not occupy a prominent position, since only 14 are included, and of these only 8 (23 per cent) are instances of uncomplicated injury to the gut. Secondly, it is shown that in a large proportion of the cases the wound traversed the upper part of the abdominal cavity, since in no less than half the whole number a hæmothorax was present. Thirdly, the multiple nature of visceral gunshot injuries is well brought out. Thus amongst the 17 cases in which a hæmothorax was present, in 9 the liver was also injured, in

2 the liver and right kidney, in 1 the spleen and left kidney, in 1 the spleen and both kidneys, in 1 the spleen and the transverse colon, in 1 the pancreas, liver and stomach, in 1 the left kidney, and in 1 the right kidney alone.

POST-MORTEM FINDINGS IN THIRTY-FOUR CASES OF ABDOMINAL INJURY, BY LIEUTENANT H. HENRY.

Abdominal injury	Complications	Death from	Missile
Liver	Hæmothorax	Secondary liver hæmorrhage	Bullet.
Liver	Hæmothorax	Secondary liver hæmorrhage	Shell.
Left kidney	Hæmothorax	Secondary kidney hæmorrhage	Bullet.
Liver	..	Sepsis	Shell.
Pelvis (no intraperitoneal damage)	..	Septicæmia	Shell.
Spleen and left kidney ..	Hæmothorax and fractured spine	Meningitis	Bullet.
Liver	Hæmothorax	?	Bullet.
Jejunum and pelvic colon..	..	Peritonitis	? Shell.
Spleen and transverse colon	Hæmothorax	Septicæmia (streptococcal) ..	? Shell.
Pancreas, contusion of stomach and liver	Hæmothorax	Secondary liver hæmorrhage	Bullet.
Liver	..	Secondary liver hæmorrhage	Shell.
Liver	Hæmothorax	Secondary liver hæmorrhage	? Shell.
Liver and right kidney ..	Hæmothorax	Gas gangrene	Bullet.
Spleen, right and left kidneys	Hæmothorax	Secondary hæmorrhage ..	Bullet.
Liver, jejunum, contused stomach	..	Peritonitis	Bullet.
Descending colon, small intestine	..	Peritonitis	? Bullet.
Ascending colon	..	Gas gangrene	Shell.
Liver and right kidney ..	..	Gas gangrene	Shell.
Jejunum	..	Peritonitis	Bullet.
Liver	Hæmothorax	Septicæmia (streptococcal) ..	Shell.
Right kidney and duodenum	..	Septicæmia	? Bullet.
Liver	Hæmothorax	Septicæmia	Bullet.
Ascending colon	..	Gas gangrene	? Bullet.
Liver	Hæmothorax	Septicæmia (streptococcal) ..	Shell.
Liver and right kidney ..	Hæmothorax	Gas gangrene	Shell.
Transverse colon.. ..	..	Septicæmia	Shrapnel.
Right kidney	Hæmothorax	Septicæmia	Shell.
Ileum	..	General peritonitis ..	Shell.
Right kidney	..	Gas gangrene	? Shell.
Liver	Hæmothorax	Secondary liver hæmorrhage	Shell.
Stomach	..	Septicæmia	Bullet.
Small intestine	..	Peritonitis	? Shell.
Liver	Hæmothorax	Septicæmia	Bullet.
Rectum extraperitoneal ..	..	Hæmorrhage from branch internal iliac	? Bullet.

In no case were multiple injuries of the intestine observed, and this fact, in connexion with the practical limitation of the wounds to the upper part of the abdominal cavity, sufficiently emphasizes the fatality attending wounds of the intestine in the central portion of the abdomen, few patients surviving to reach even the post-mortem table of the general hospitals.

It will be observed that of the 34 cases included in Lieutenant Henry's table, the injuries were produced in 16 instances by shell fragments, in 15 by bullets, and in 1 a shrapnel ball.

The General Diagnosis of Perforation of the Gastro-intestinal Tract by Gunshot Injury.

Observation of a large number of the abdominal injuries in warfare naturally raises the question, Can we either immediately or even after the lapse of some days certainly discriminate between those in which perforation of the gastro-intestinal tract has occurred, and those in which the stomach and intestines have escaped?

I believe that with the means we have at hand this question must be unhesitatingly answered in the negative, and before proceeding to a consideration of the injuries of special portions of the canal I propose to shortly discuss the difficulties which confront us.

Indisputable proof is afforded by two conditions: one, the presence of a wound of the gut seen either through a wide defect in the abdominal parietes or in a prolapsed loop, the second lies in the obvious escape of intestinal contents of a fluid or more or less solid nature. To these may perhaps be added the presence of free gas in the peritoneal cavity, but this, although a valuable sign, is liable to be assumed to be present when the resonance is really due to intestinal distension. For this reason the sign cannot be placed on a level with the two former which are capable of ocular demonstration.

If we examine the whole of the remaining signs, a complex of which is usually relied upon for a diagnosis of perforation of the gut, we find the entire series to be capable of misconstruction.

Of the general condition of the patient little need be said, because in these injuries, as in gunshot wounds of other regions, the amount of shock is very variable, and a severe degree is of as little importance in establishing a certain diagnosis as is a slight degree in the direction of furnishing negative evidence.

The rising of the pulse-rate is a sign of the greatest weight, since upon it more than any other single indication may rest the decision as to whether an abdominal exploration is to be made in so many instances of abdominal lesion in civil practice. I do not think that equal importance can be ascribed to the condition of the pulse in gunshot injuries, even should the wound appear to have traversed an area occupied by intestine alone, but this opinion is still further strengthened when the course of the track crosses the

area occupied by other viscera. Two main conditions diminish the confidence to be placed upon a rise in the pulse-rate: first, the almost inevitable association of hæmorrhage with or without the intestinal lesion, and second, the common existence of multiple lesions of contiguous viscera. Either of these conditions may lead us to misconstrue a change in the pulse-rate, while frequently neither is capable of certain determination.

The bodily temperature is of far less importance and rarely aids in a diagnosis. Again, rapidity of respiration, often a valuable sign of commencing septic absorption in abdominal cases, is not infrequently observed in abdominal gunshot wounds without serious visceral injury being present, and the symptom obtains still lesser importance when the wound involves both the abdominal and thoracic cavities.

The occurrence of vomiting is an uncertain symptom, in some cases of undoubted perforation it is early and constant, in others late or absent, while it is a prominent feature of many abdominal wounds in which no visceral injury exists. Constipation, again, the common sequence of a gunshot wound of the intestine, is in a considerable proportion of the cases replaced by diarrhœa. More valuable are the occurrence of hæmatemesis or melæna, but here again no certain deduction can be drawn as to their dependence on wound or contusion of the bowel wall, while as gross signs either may be absent in cases in which there is little apparent reason to doubt a perforating visceral injury. An immediate urgent action of the bowels is rare, while incontinence is often seen with a sacral wound whether the lower bowel be injured or not.

Distension, local pain and tenderness on palpation, local immobility of the abdominal wall, muscular rigidity, local dulness in the flanks or elsewhere, are all signs capable of so varied interpretation as to be of value only as parts of a complex which still may be capable of misconstruction.

Lastly, we may consider one valuable indication, the position of the external wound or wounds and the course and direction of the track. One fact is indisputable, antero-posterior tracks in the central area of the abdomen, and tracks which course transversely between the costal arch and the crests of the ilia are practically never seen at the base hospitals without evidence of intestinal injury and even with the latter proviso they are distinctly rare. Hence we may assume that the large majority of patients suffering such injuries die at the field ambulances or casualty clearing stations, because wounds in the upper half of the abdomen or

those traversing the upper abdomen and thorax or the lower abdomen and pelvis are met with in considerable numbers at the base, and many recover.

Here, again, no certain conclusion as to a perforating injury can be come to in spite of a bullet having apparently traversed the most dangerous portions of the abdominal cavity, for patients with such wounds occasionally recover, while little evidence exists to prove that perforating injuries to the small intestine ever heal spontaneously. Reference to this subject will again be made in the next section and under the heading of the small intestine.

Wounds of the Abdomen in which no definite Visceral Injury can be proved.

Before proceeding to a consideration of perforating injuries of the alimentary tract, it may be of interest in relation to difficulties in diagnosis to shortly survey a series of fifty-two cases in which, either from the position of the external wounds or their attendant symptoms, visceral injury was suspected to have occurred.

Notes of these cases were taken during the same period as that in which the actual perforating visceral lesions were observed, a number of superficial or obviously contour wounds under treatment at the same time being purposely omitted.

It may first be noted with regard to causation that forty of the wounds were produced by bullets, four by fragments of shells, one by a shrapnel ball, while in seven no record of the occasioning missile has been kept. Further, it should be stated that in twenty-nine cases (53·8 per cent.) the bullet or shell fragment was retained. The inferences to be drawn from these facts are clear: (1) That bullet wounds are less dangerous than those produced by fragments of shells; (2) that the injuries were produced by missiles travelling at a low degree of velocity since so many were retained, and (3) that retention of the missile as direct evidence of perforation of the peritoneal cavity may be the cause of difficulty in arriving at an early diagnosis, but is not a definite indication for surgical exploration.

With regard to the position of the external wounds they may be roughly classified as follows:—

Epigastrium 9, umbilical region 9, hypogastrium 1, right iliac fossa 8, between the anterior and posterior axillary lines 7, loin 8, back 2, traversing the ilium 1, buttock 5. The remaining two were very extensive lacerated wounds of the right hypochondrium and right iliac fossa, in neither of which could perforation of the abdominal cavity be at first excluded.

Evidence of actual perforation of the peritoneal cavity was offered in three by extrusion of omentum from the wound, in three by negative surgical explorations of the abdomen, in one by the removal of the bullet from the peritoneal cavity, and in a considerable proportion by the position of the retained bullet.

The organs in which injury was suspected are roughly as follows: stomach 8, small intestine 25, colon 9, liver 5, kidney 1, ureter 1; in the two cases with extensive lacerations of the abdominal wall no special viscus was singled out.

In only 12 of the patients was the suspicion not supported by the presence of symptoms or physical signs, such as hæmatemesis 4, melæna 2, free vomiting 20, abdominal distension 12, tenderness and rigidity 14, absent liver dulness 4, and the development of secondary abscesses 3. In 4 patients who died the visceral injury suspected was not found.

The absence of symptoms or signs in cases of injury to the liver, kidneys, urinary bladder, and perhaps also the stomach, cannot be accepted as proof that any of these viscera have not been wounded, or that recovery is impossible. In the case of the small intestine there is little evidence that traumatic perforating lesions are ever recovered from spontaneously, but a great deal to the contrary. As this question is one of such serious import with regard to the adoption of operative methods of treatment, it may be well to shortly summarize what is known on the subject.

(1) It may be premised that the experience of civil practice is to the effect that a rupture of the small intestine is a fatal injury unless the rent be repaired by surgical methods. It may be added that even operative methods have been followed by but a very moderate proportion of recoveries.

(2) Minimal gunshot perforations of the small intestine, so minute as not to allow the contents of the gut to be pressed out on manipulation so soon as thirty-six hours after infliction, may yet be evidenced by the presence of abundant free gas in the peritoneal cavity and well-marked signs of peritoneal infection and prove fatal (see Case 1).

(3) In cases which survive several days it is not rare to find only a single perforation of the gut, and such perforations are then most commonly situated in the more fixed portions of the small intestine, e.g., duodenum, upper part of jejunum, or lower part of the ileum, in fact the segments of the bowel that cannot well escape injury by displacement.

(4) Post-mortem evidence of healed perforating gunshot wounds of the small intestine is wanting.

(5) Post-mortem examination not infrequently discloses perforating lesions of other viscera by bullets which have traversed the area occupied by the more movable parts of the small intestine without inflicting any perforating injury to the gut.

(6) Both under the conditions detailed in (5), and even when a perforating lesion is discovered in one or more coils of bowel, non-perforating grooves, or bruises and ecchymosis of other coils may afford direct evidence of contusion without perforation.

(7) Wound tracks traversing the peritoneal cavity from side to side between the limits marked above by the costal arch and below by the iliac crests, which involve an area in which the small intestine can hardly escape by displacement, are almost invariably fatal, and in such cases the perforations of the gut are commonly multiple.

Such evidence as exists, therefore, is strongly opposed to the occurrence of spontaneous healing of these injuries, while it definitely supports the view that bullets may traverse the area occupied by the small intestines without causing any fatal damage to the patient. Six of the cases dealt with in this section, both as affording evidence of the difficulties in diagnosis and as of special interest in themselves, may be shortly detailed.

Case 1.—Under the care of Major Dyer. Minimal Perforation of the Small Intestine. A bullet struck the stock of a revolver and fragmented, one fragment passed through the centre of the right rectus at the level of the umbilicus. The patient was little upset, and in the absence of any primary symptoms he was sent down to the base, where he arrived thirty hours after the reception of the injury. He became worse during the railway journey, and on admission to hospital was vomiting black offensive fluid, and looked very ill. The abdomen was distended and rigid, the liver dulness was obliterated, and there were no signs of fluid in the flanks. An abdominal section was decided upon, a right paramedian incision was made and this disclosed an injury to a single coil of intestine. The peritoneal cavity was highly distended with gas and a small collection of peritoneal fluid occupied the pelvis. There was no evidence of gross escape of contents from the wounded coil, the surface of which was covered with recent lymph, and even on manipulation none of the fluid contents of the bowel escaped from the minute opening. The latter was closed by a few stitches, the coil washed, and the abdomen was closed except that a drainage tube extending into the pelvis was fixed at the lower end of the incision in the abdominal wall. The local condition subse-

quently appeared quite satisfactory, but the patient became delirious on the third day and died in a state of great excitement on the fourth day. No post-mortem examination was made. The case is quoted as illustrating the serious effect of a perforating wound of the small intestine even when of no greater extent than a slight puncture.

Case 2.—Under the care of Captain Wolfenden. Retroperitoneal Gaseous Cellulitis. A man was admitted on the fourth day after injury. A piece of shrapnel case had perforated the left ilium and was retained. Vomiting commenced on the second day and continued frequent throughout. On the day of admission the abdomen was highly distended, immobile and tender, the tongue was dry and furred, and there was some diarrhœa. Temperature subnormal, pulse 130 very small, the hands were cold, and respiration was rapid and grunting. An injury to the intestine and consequent general peritonitis were assumed. On the following day the man died. A post-mortem examination disclosed no injury to the intestine, but an extensive retroperitoneal gaseous cellulitis.

Case 3.—Under the care of Lieutenant-Colonel Butler. Contour Wound of the Abdominal Wall. The bullet entered just below and to the left of the umbilicus, and was retained in the loin. On admission there was much ecchymosis around the aperture of entry and from the latter gas and brown fæcal smelling discharge was escaping freely. The man's general condition was good, but the nature of the discharge suggested an intestinal injury. The wound was opened up and the man did well, the discharge lost its fæcal odour, and became simply purulent, and the patient was sent to England in a few days. This case is quoted as an example of the difficulty which may be raised by the apparently fæcal nature of a discharge, which is really only the result of anaerobic infection of extravasated blood. Similar difficulty is not uncommon in wounds of the loin under the same circumstances.

Case 4.—Under the care of Captain Mumford. Retroperitoneal Gaseous Cellulitis and Anaerobic Peritoneal Infection. A man with an entry wound just above the iliac crest in the right posterior axillary line was admitted on the fourth day. The bullet was retained. On admission the patient was paraplegic (? concussion only), there was an abundant fæcal smelling discharge from the entry wound, and the abdomen was highly distended, rigid and tender. The bowels acted with a glycerine enema. On the fifth day the man commenced to vomit frequently, his general condition

became steadily worse, and on the sixth day he died. At the post-mortem examination (Lieutenant Shelley) the peritoneal cavity was found distended by free gas, and the whole small intestine was dilated. The lower six inches of the ileum, the cæcum and the appendix, were adherent to the anterior abdominal wall, but no trace of any perforation could be discovered. The omentum was rolled up, indurated, and of the green colour seen in mixed anaerobic infections of the cellular tissue. There was gaseous cellulitis of the retroperitoneal cellular tissue and of the psoas muscle. The bullet was not discovered.

Case 5.—Intraperitoneal Hæmorrhage (under the care of Captain Clementi Smith). The man was wounded twelve days before admission, and as an intestinal injury was assumed he had been retained at the casualty clearing station for that period. The journey to the base was badly borne, aud the patient was admitted in a moribund condition. On the following day he had somewhat improved, and a large gaseous abscess was diagnosed in the right iliac region, the bullet having entered the centre of the left rectus at the level of the umbilicus and being retained. The abscess was incised and a large quantity of decomposing blood mixed with peritoneal fluid and flakes of lymph was evacuated from a cavity bounded by the cæcum and ascending colon, and internally by adhering coils of small intestine. The patient improved rapidly, but nine days later a similar abscess became evident in the right hypochondrium and epigastrium. Decomposing blood clot was again evacuated. Both the cavities suppurated, but rapidly contracted, and at the end of six weeks the man was transferred to England practically well. The blood was probably mesenteric in origin.

Case 6.—Under the care of Captain Wolfenden. Thrombosis of Mesenteric Veins. A man wounded by a bullet entering to the right of the twelfth dorsal spine and emerging beneath the costal margin in the left axillary line, was admitted on the fourth day with a distended rigid tender abdomen. Dulness and ecchymosis developed in the left flank, and on the seventh day an apparently fæcal discharge commenced from the exit wound. At the end of fourteen days the man commenced to vomit frequently, and died on the fifteenth day. At the post-mortem examination no trace of any intestinal wound was discoverable, but the mesenteric veins were thrombosed and the intestine gangrenous.

Wounds of the Stomach.

The stomach appears to be the only segment of the alimentary canal within the abdomen in which spontaneous healing of a perforating lesion without the development of positive evidence takes place with any degree of frequency. This assumption, however, aids little in the formation of a diagnosis of existence of a gastric lesion, but rather introduces an incalculable element into the consideration of any doubtful case.

Thus, while on the one hand a certain conclusion that any particular viscus has suffered can seldom be arrived at by a simple observation of the position of the apertures of entry and exit when a missile has traversed the trunk, or of the aperture of entry when the missile is retained; on the other, we know that a perforating lesion may be unaccompanied by any distinctive symptoms and signs.

The evidence in favour of spontaneous healing does not, however, depend on the assumption that the position of the wounds makes it difficult to believe the stomach has escaped injury, although tracks entering at the epigastrium or traversing the lower confines of the thorax transversely or obliquely are common.

The more certain evidence is offered by the discovery of perforating lesions at post-mortem examinations where the patient has died from other causes than peritoneal infection. The following case is an illustration :—

Case 1.—Under the care of Dr. Graham Jones. A man was struck over the lower left ribs by three pieces of shrapnel case ; two fragments were localized by an X-ray examination in the muscles of the back, the third was not found.

The patient vomited frequently immediately after being struck "twenty times" but not again. No blood was noticed in the vomit, and no abdominal symptoms or physical signs developed. Eight days later, without any previous warning, an attack of hæmatemesis occurred, followed by the passage of blood in the stools. The abdomen became suddenly distended but with no evidence of free gas in the peritoneal cavity. There was tenderness in the epigastrium and some dulness in the left flank. The patient sank rapidly and died in twenty-four hours. At the post-mortem examination some free blood was present in the peritoneal cavity, and a large quantity in the stomach itself. A perforation was found in the posterior wall of the stomach near the mid point of the lesser curvature. The perforation was no longer patent and the stomach wall around the wound was firmly adherent to the

surface of the pancreas and also to the spleen. There were no signs of further peritonitis. The fragment of shell was not found in the alimentary canal and had no doubt escaped per anum. Apart from the accident of secondary hæmorrhage there is little doubt that this patient would have recovered. With regard to the question whether patients with perforating gastric lesions recover except as a consequence of direct and early adhesion to contiguous viscera, I can only say that I have not come across any left subphrenic abscess attributable to this cause, nor any local peritoneal collection in connection with other parts of the viscus (*vide* Duodenum).

Case 1 raises the question of the value of the symptom of hæmatemesis in the diagnosis of a gastric perforation. It will be noted that no primary hæmatemesis was observed, while simple vomiting accompanies many non-perforating lesions, and this is not an uncommon observation in patients when a gastric perforation is assumed from the position of the external wounds. On the other hand, hæmatemesis of a profuse character is not rare when no perforation can be found on post-mortem examination, or where the subsequent course of the case gives no support to the diagnosis. As this subject is one of great clinical interest three illustrative cases may be given.

Case 2.—Under the care of Captain Anthony Bradford. The man was struck by a bullet entering the seventh left intercostal space in the posterior axillary line, and emerging one inch below the left nipple. The reception of the wound was followed shortly by a vomit of a pint of blood, and for the next two days blood was passed with the stools in considerable quantity. A hæmopericardium and a left hæmothorax developed, and a right streptococcus empyema formed and required to be drained later. The man recovered, but during the period of drainage suspicion was raised as to the escape of gastric secretion with the discharge, although no food elements were detected.

Case 3.—Under the care of Dr. Ronald Gray. A man was struck by a bullet entering the highest part of the epigastrium and emerging in the left loin. When seen thirty-six hours later he was vomiting dark, bloody, stinking fluid, and there were distinct signs and symptoms of peritonitis. The general condition of the patient forbade the performance of an operation, and during the night he died. The post-mortem examination disclosed no perforation of the stomach, but more than half of the viscus was in a state of incipient gangrene. The bullet had divided all the vessels of the

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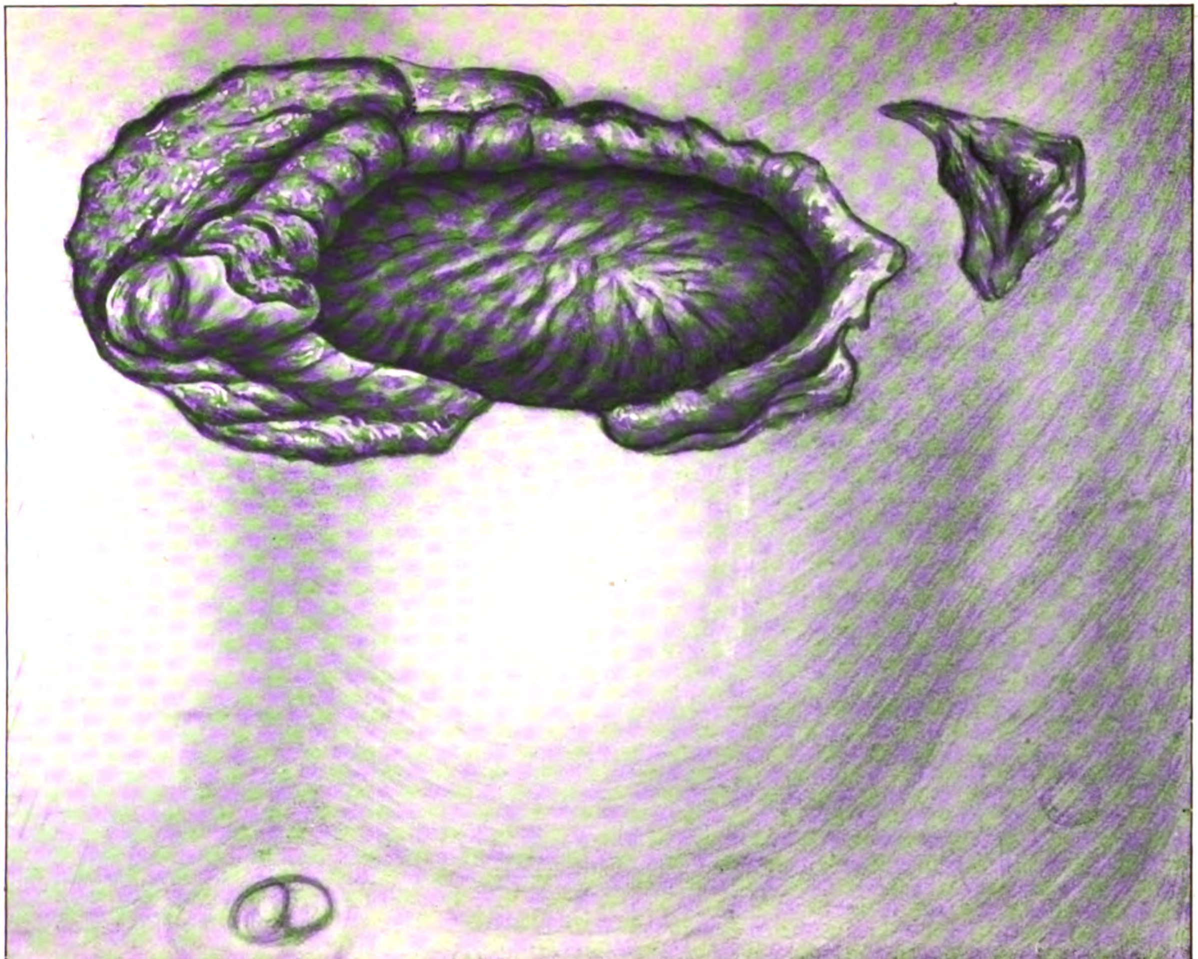

FIG. 5.—Perforating lacerated wounds of the abdominal wall. The aperture of entry to the right is small and triangular, the large exit opening is bounded by the structures of the whole thickness of the abdominal wall and floored by the anterior surface of the stomach. From a drawing by Colonel Cree, R.A.M.C.

gastro-splenic omentum in its passage, and the left kidney was comminuted.

Case 4.—Autopsy by Lieutenant H. Henry. A man shot across the lower part of the thorax died mainly as a result of an extensive right hæmothorax. At the post-mortem examination made by Lieutenant Henry the following lesions were found in the abdomen: (1) A wound of the right half of the diaphragm; (2) a clean oblique perforation of the right kidney; (3) a large hæmorrhage into the lesser sac, with secondary leakage into the general peritoneal cavity; (4) blood in the stomach and duodenum, but no sign of any perforation, neither did the blood in the peritoneal cavity show any signs of sepsis; (5) shattering of the upper pole of the left kidney; (6) extensive infarction of the spleen, but no evidence of injury to the splenic vessels.

Case 5.—Under the care of Captain Clementi Smith. A boy of 16. A piece of shrapnel case had entered just above the xiphisternum and remained lodged in the right rectus muscle two and a half inches below. When seen on the second day the boy was in great pain, temperature 103°, pulse 102, respiration 24. The tongue was furred and yellow, but there was no vomiting. The abdomen was rigid and retracted and moved little with respiration. Percussion elicited a wide area of stomach tympany. During the night the bowels acted several times, a large quantity of blood being passed. Frequent actions of the bowels with melæna persisted for the ensuing twenty-four hours. The next day the general conditions had improved, while on the fourth day the patient looked practically well. Fig. 5, a drawing of a case under the care of Captain Greaves, forms a striking contrast to Case 5. It is to be assumed that the application of the force in a purely transverse direction saved the stomach from contusion, for in this instance absolutely no evidence of injury to the stomach existed.

These six cases illustrate well the difficulty which arises in assigning the proper importance to either hæmatemesis or melæna in the determination of a perforation of the wall of the stomach. First of all, they show clearly that it is as likely to accompany a contusion as a wound; secondly, that its occurrence as a primary sign may be absent, and that as a secondary accident no more definite significance can be assigned to it. Other points of interest are raised: (1) The difficulty in discovering the actual bleeding spot; (2) the remarkable occurrence of gangrene in Case 3 as a result of interference with one source alone of the blood supply of the stomach; (3) the multiple nature of the visceral lesions in

abdominal wounds; (4) the danger which exists of secondary hæmorrhage in patients with a possible stomach wound where no early symptoms follow its infliction, and (5) the late date at which secondary hæmorrhage may occur.

The presence of the wound in the right side of the diaphragm in Case 4 was in that instance of little importance, but it should be borne in mind that a wound of the left side of the muscle has more than once been followed by a hernia of the stomach into the left pleural cavity.

It is clear, in the presence of such varying symptoms, that a diagnosis of perforation of the stomach cannot be certainly made in a great number of the abdominal wounds in which such an accident is possible, hence an expectant attitude in the matter of treatment must always be assumed. Further, in the belief that spontaneous recovery does occur after this injury, while it is practically impossible in many cases to exclude the existence of a contusion only, it is reasonable to say that operative interference is more rarely advisable here than in any other injury to the alimentary canal. It should be borne in mind, moreover, that probably the cases most likely to recover spontaneously are those in which the posterior aspect near the lesser curvature of the organ is the part wounded, the most inconvenient situation for operative manipulation.

Wounds of the Small Intestine.

Among the series are included 25 cases of certain injury to the small intestine caused in 20 instances by bullets, and in 5 by small fragments of shells. Three patients with bullet wounds survived and one of those injured by shell fragments. The small proportion of shell wounds is probably due to the great fatality of such injuries at an earlier stage of the cases, but in this small series no difference in the average mortality is shown. The mortality of 84 per cent in no respect represents that of perforating wounds of the small intestine, since it was observed amongst patients who for the most part survived the immediate dangers of the injury, and were well enough to reach the general hospital. One observation is sufficient to illustrate this fact, no one of the cases included died from hæmorrhage, to which cause is ascribed so many of the deaths seen in the field ambulances and clearing stations. On the other hand, as post-mortem examinations were made in only 7 of the included instances, it is impossible to exclude the general influence on the

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FIG. 6.—Skiagram showing infiltration and dissection of the structures of the thigh, by gas and intestinal contents in the case referred to in the text.

Skiagram by Captain Curtis Webb. This and Fig. 7 are of special interest as being probably the first illustrations of gas infiltrating a limb. As a consequence of the result obtained the method was introduced as a diagnostic aid in the examination of cases of gaseous cellulitis due to anaerobic infection.

mortality of concurrent injury to other viscera unaccompanied by clinical signs, while in 5 instances complicating injuries of other hollow viscera is certain. The series does not appear to raise any doubt as to the enormous mortality which attends wounds of the small intestine, although in one instance in which a fistulous opening formed eventual spontaneous recovery took place. This case of recovery occurred in an Indian soldier, which makes it of less moment since, according to my observation, Indians recover from injuries which in most cases would prove certainly fatal to Europeans.

Case 1.—Under the care of Captain West, I.M.S. Bullet wound, aperture of entry at the centre of the right buttock, exit at a corresponding point in the left buttock. Discharge of intestinal contents was first noted on the fourth day, and evidence as to its source and nature depended mainly on the digestion of the skin around the wounds. The discharge persisted in small quantity for eighteen days, after which time the wounds healed. It will be noted that as the discharge was not observed until the fourth day it is possible that the perforation of the bowel may have been secondary in nature, a severe primarily contused spot in the bowel wall only having given way after the formation of protecting adhesions.

A definite localization of the point at which the bowel may have been perforated is impossible from the fact that amongst the twenty fatal cases ten only were subjected to exploration or post-mortem examination, but from these latter some points of interest emerge. Two cases were wounds of the second portion of the duodenum, a very fixed portion of the bowel unable to be displaced by the lateral force exerted by the bullet, each was followed by the development of a duodenal fistula, and in each the right kidney was slightly implicated, suggesting that both wounds were mainly retroperitoneal in position and also that the perforation was possibly secondary in nature. The latter supposition is further supported by the fact that in neither instance did a general peritonitis follow the injury, and both patients died from general septic absorption.

Case 2.—The early history of this case has been already published by Captain Owen Richards (*Brit. Med. Journ.*, August 7, 1915). The fistula followed an exploratory operation performed at the end of the third day after the reception of the injury. A collection of dirty grey fluid and gas localized by adherent viscera was found which escaped from a hole at the bottom of the cavity. On the tenth day

the patient was transferred to Boulogne in good general condition; but he died later from septic absorption and exhaustion on the twenty-second day, although little escape of duodenal contents took place during the last week of life. At the autopsy made by Lieutenant Henry, an opening into the duodenum at the bend between the second and third parts was found, and the duodenum was adherent to a groove on the lower pole of the right kidney. Some small pockets of pus were situated around the fistula, and plastic lymph was present over the under surface of the diaphragm and the upper surface of the liver. A recent purulent right pleurisy was also found.

Case 3.—Under the care of Lieutenant Colquhoun. An abscess in the right loin was opened on the seventeenth day, and a fæcal fistula was promptly established. The patient survived ten days, eventually dying of septic absorption and exhaustion. At the autopsy a wound of the second part of the duodenum was found, the gut being firmly adherent to the lower pole of the right kidney; also, a wound of the hepatic flexure of the colon.

As in all cases examined with colic wounds a general gas infection was present (Lieutenant Henry), the liver was mottled with discrete gaseous patches, and gas bubbled freely from the vessels. As further evidence of the general nature of the anaerobic infection a patch of gaseous cellulitis was present on the chest wall at the site of a recent saline infusion. Recent broncho-pneumonia was also found. A striking feature in each of these cases, their long duration, twenty-two and ten days respectively, is no doubt mainly to be explained by the position of the wound, but beyond this there is no doubt that the higher the wound is situated in the intestine the less acutely infective are the escaping contents to the peritoneum or surrounding tissues.

With regard to the remaining twenty-three cases, in nine no opportunity of localizing the position of the wound in the intestine occurred, but of nine cases which were examined, either during life or after death, four were of the jejunum and five of the ileum. In six of these the wounds were of a limited nature, and situated either in the comparatively fixed parts of the commencement of the jejunum or termination of the ileum. This observation affords evidence, first of the more serious results and early death of multiple intestinal wounds, and, second, the vulnerability of the more fixed portions of the small intestine.

Causes of Death.—While reports from the field ambulances and casualty clearing stations show the immediate cause of death after

injury to the small intestine to be frequently due to hæmorrhage and peritonitis of a limited extent, the almost constant cause of death in those patients who survive to reach the general hospitals from the third day onwards, is general peritoneal infection, as a rule of a dry adhesive nature, accompanied by neither local nor general fluid effusion. The antecedent clinical signs are those of atonic intestinal obstruction, but these are of the same nature as are seen in cases of general peritoneal infection from any other cause, and it is manifestly incorrect to ascribe the death of the patients to this one secondary effect of infection of the peritoneal cavity. The special peculiarity of the fatal cases of gunshot wounds is the common association of injuries of both small and large intestine, or of other viscera, such as the solid organs or the urinary bladder. In this small series in three cases injuries to both small and large intestine were present; in a third the small intestine and bladder; in a fourth the small intestine and stomach, and in at least two others the kidney was concurrently wounded, while in the large number of cases in which neither autopsy nor exploration was made no certainty exists as to this particular. Again, in the series of fifty-six wounds of the colon dealt with below, in seven a concurrent injury of the small intestine was probably the main cause of the fatal issue. It will be observed that no case of perforating wound traversing the area occupied by the small intestine, but unaccompanied by clinical symptoms or sepsis, is included in this series; this for two reasons, first, this occurrence has been of extreme rarity at the base hospitals in this campaign; and, secondly, I do not believe that any evidence exists to show that a perforation of the small intestine, however minute, fails to give rise to symptoms suggestive of the injury, while evidence has already been adduced to show that a bullet may traverse the area occupied by the more movable coils of gut without causing any perforation.

Clinical Signs and Diagnosis.—It seems superfluous to recount the familiar and classical signs of peritonitis following an intestinal perforation, the same variations in the individual signs are seen as occur in peritoneal infection from other causes, thus frequency or absence of vomiting, constipation or diarrhœa, distension or retraction of the abdomen, and varying degrees of immobility or rigidity of the abdominal wall. Local fixed tenderness and the early presence of free gas in the peritoneal cavity, together with the position and course of the wound are, perhaps, the most valuable diagnostic aids in the initial stages. Later, appearances suggesting the occurrence of a secondary perforation or extension of local

mischief may be very difficult of interpretation. Secondary hæmorrhage into the bowel, into the peritoneal cavity, or into the retroperitoneal tissue may each and all cause difficulty, and the diagnosis only be cleared up at an autopsy, but the possibility of any of these accidents must be borne in mind. The degree of anæmia, melæna, the presence of signs of fluid in the flanks (rare in peritonitis from gunshot perforations of the small intestine), the development of a local tumour or a gaseous abscess are the chief aids on which reliance can be placed in excluding the small intestine as the site of injury in these circumstances, and it may also be remembered that secondary hæmorrhages are not infrequently accompanied by a considerable rise in the bodily temperature.

One special source of error in cases of pelvic wound should receive mention. In many cases of extraperitoneal wound of the bladder, local tenderness, distension, together with immobility and rigidity of the lower abdomen may strongly suggest a wound of the coils of small intestine occupying the pelvis. Time will usually rectify this error. The obvious local collection of fluid forming a dome-shaped induration of the abdominal wall in the hypogastrium, and sooner or later exciting suppuration, will demand an incision and the matter is set at rest.

In concluding these remarks on the symptoms and diagnosis, a case of great interest in illustrating how the course of extension of extravasation of intestinal contents may be influenced by the presence of a bullet track may be briefly detailed.

Case 4.—Under the care of Dr. Ronald Gray. A man was wounded by a bullet entering above the centre of Poupart's ligament on the left side, the bullet was shown by an X-ray picture to lie imbedded in the right iliac fossa. The patient was retained at the casualty clearing station for a week, and when admitted at the general hospital the abdomen was fairly normal, but the right thigh was greatly swollen, and the man suffered intense pain. Bearing in mind the course taken by the bullet, I was inclined to ascribe the swelling of the thigh to a collection of extravasated urine escaping from a wounded bladder, as I was familiar with this form of urinary extravasation in gun-shot injuries. A skiagram was therefore taken to determine whether a fractured pelvis was present. The plate (fig. 7) showed a dissection of the muscles of the thigh, particularly of the adductor region, and the presence of a large quantity of gas in the intermuscular spaces which were widely distended. A wound of the cæcum was then assumed to be present, and free incisions were made into the thigh by Captain Martin and a large quantity of

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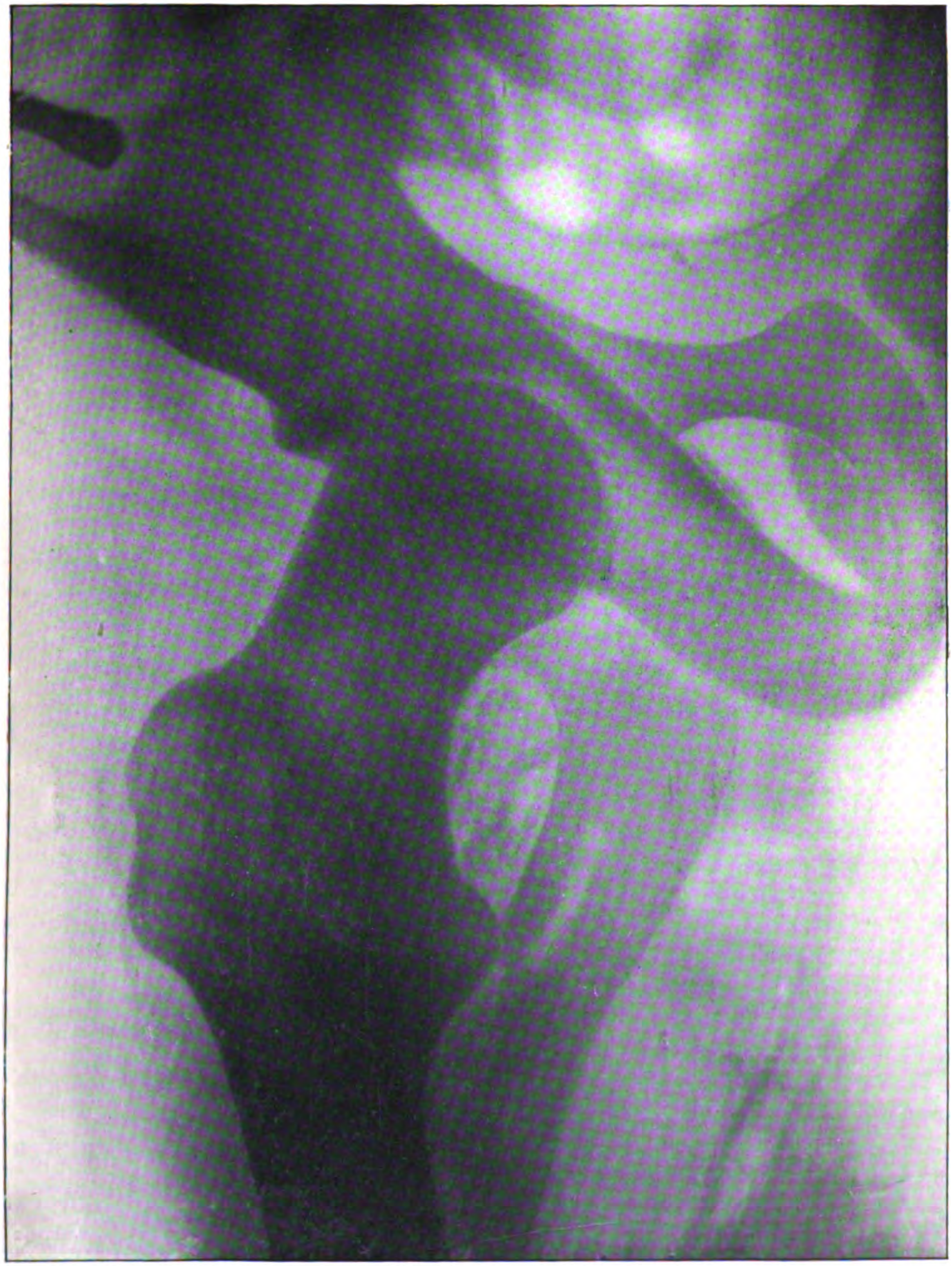

FIG. 7.—Skiagram showing infiltration and dissection of the structures of the thigh, by gas and intestinal contents in the case referred to in the text.

Skiagram by Captain Curtis Webb. This and Fig. 6 are of special interest as being probably the first illustrations of gas infiltrating a limb. As a consequence of the result obtained the method was introduced as a diagnostic aid in the examination of cases of gaseous cellulitis due to anaerobic infection.

fluid fæces and gas evacuated. The operation gave little relief, for the digestive action of the escaping intestinal contents attacked a large area of the skin of the thigh, and deep extravasation in the limb extended. An attempt was made to perform an ileo-transverse colostomy, but when the abdomen was opened the peritoneal adhesions disclosed were so dense and general that the intention had to be abandoned and simple local drainage substituted. The operation merely resulted in an extension of the infection and the patient succumbed on the following day, the seventeenth after reception of the injury. At the post-mortem examination the course taken by the bullet appeared to be mapped out by a densely matted series of adhesions between the omentum and the lowest six inches of the ileum. In the latter it was impossible to localize any particular opening, but it appeared probable that several had been originally present which had been more or less completely closed by the adherent omentum. From the canal thus formed, the contents escaping from the small intestine had entered the psoas sheath, digested the muscle and following down the sheath entered the thigh in the adductor region and eventually invaded the whole of the inner and back parts of the limb. A similar course taken by the contents of the ascending colon will be referred to in the next section.

Treatment of Wounds of the Small Intestine.—This subject belongs in the main to the work of the casualty clearing stations, since it is a rare event for cases suitable for operation to reach the general hospitals sufficiently early to warrant operative interference. Still cases occasionally arrive during the first thirty-six hours. On three such patients operations were performed without success; in two limited injuries were present, in the third both small and large intestine were found to be wounded. All three patients succumbed to general peritoneal infection.

The important general indication afforded by this series cannot, however, be denied when we consider the only four cases in which recovery took place. Two recovered as a result of operations performed at the casualty clearing station by Captain Owen Richards. One case recovered in which free escape of intestinal contents from a wounded loop was assured by the size of the external wound, while in the fourth patient (the Indian) the fistula was probably secondary to an injury not primarily perforating in character.

It is indubitable that these results indicate that primary operation in properly selected cases affords the one and only chance of

recovery for a patient who has received a perforating wound of the small intestine.

A word may be said here as to the nature of the operation. In simple cases suture of the perforation is all that is required, but when the perforations are multiple, or when the neighbouring bowel has suffered severe contusion, or again when the mesenteric vessels have been injured, resection of the damaged coil may be necessary. Captain Owen Richards has written on this subject and with regard to his recommendation a case may be quoted in support of the method of treatment by resection.

Case 5.—Under the charge of Captain Clementi Smith. A man was admitted thirty-six hours after receiving a bullet wound of the abdomen just below the costal margin in the right nipple line. He was vomiting thick yellow fluid freely, looked very anxious and was much distressed. Otherwise the general condition was good. The abdomen was not highly distended or quite immobile, it was rigid and generally tender, and the peritoneal cavity contained free gas but no fluid.

A right paramedian incision with displacement outwards of the rectus disclosed a local hæmorrhage from the omental vessels along the inner margin of the ascending colon and apparently normal bowel. The jejunum was traced upwards and three perforations from which nothing but gas had escaped were found in the first nine inches of the jejunum, a single grooved one three inches from the junction with the duodenum and a double one some six inches lower. About the lower opening there was some bruising and ecchymosis of the bowel. The three openings were closed by two tiers of suture, the exposed loop of bowel washed and a, to all appearances, clean abdomen was closed.

The patient did not progress well; for the first three days his condition left little to be desired, but later he vomited occasionally, and diarrhœa set in. On the fifth day some temporary distension was noted, but this subsided and the abdomen looked in good condition. None the less the man continued to lose ground, on the tenth day vomiting became frequent, and on the fourteenth became fæcal. He died on the fifteenth day and at the subsequent autopsy the single wound was found healed, but some five inches of bowel including the lower perforations was gangrenous, and the stitching of both openings had given way. There were no general peritoneal adhesions, but a subphrenic abscess had recently developed.

The cause of failure here appeared to be the want of local

vitality of the portion of small intestine most severely injured, and it may reasonably be asked whether a resection of this might not have saved the man's life, for the primary conditions were at any rate as promising as those met with at most operations for a perforation of the duodenum from disease.

Lastly, the case which was cured by a secondary resection of the bowel may be shortly related, since it illustrates a form of treatment that is perhaps capable of some extension.

Case 6.—Under the care of Captain Oliver. Aperture of entry at the outer margin of the left rectus midway between the umbilicus and the pubes. Triangular exit wound of an explosive nature at a corresponding level on the right side, about half the width of the rectus having been blown away. The man came to the general hospital on the fifth day; the abdomen generally was then normal, but at the bottom of the deep wound a coil of wounded intestine permitted the escape of its entire contents, and the surrounding skin was seriously digested. On the seventeenth day the exposed coil of gut was freed and drawn out, the wounded part was excised and an end-to-end union made. Three days later the union commenced to leak and at the end of a week the discharge was free and action of the bowels per anum ceased. It was clear that the operation had failed, probably because a free enough resection had not been made. On the tenth day the operation was repeated, on this occasion about six inches of bowel being resected from each end. The second operation proved successful and the patient was sent home fourteen days later.

In three other cases in which patients arrived with extruded gut no operation was performed on two because in one a concurrent injury to the bladder existed, and in the other a wound of the large intestine. Both died shortly after arrival. In the third the extrusion was large and the openings multiple. This patient died shortly after operation.

In this relation I may mention that during a recent visit to Professor Vidal's wards in Paris I saw a patient who had suffered a perforation during an attack of typhoid fever treated by simply drawing out the perforated loop to form a fistula and the insertion of a pelvic drain. Two weeks later the patient was in excellent condition and nearly ready for an operation for closure of the fistula. A very short and rapid operation had sufficed to save the patient's life at a dangerous moment.

In the case of a gunshot wound of the abdomen, and an extruded coil of perforated gut, it would seem that the safest course is to fix

it, and not take the more dangerous course of suturing the perforation and returning the gut into an otherwise clean abdomen.

Wounds of the Colon.

The series included 56 wounds of the colon, caused in 34 instances by bullets, in 9 by fragments of shell, and in 13 no detail on this point has been preserved. The same remark applies here as in the case of the small intestine; the more serious shell wounds no doubt did not survive to reach the general hospitals. As to the cases included, little difference in either the severity of the injuries or in the mortality was observed; this fact is readily explained by the serious nature of the wounds often inflicted by the German bullet. In 10 cases wounds of the colon were complicated by concurrent injuries, in 7 by wound of the small intestine, all fatal; in one each by wounds of the liver and spleen, and in one by a large retroperitoneal hæmorrhage; in these three latter a fatal issue also ensued.

Of the 56 cases, 30 recovered sufficiently to be sent to England, while 26 died, a mortality of 46·4 per cent. If the 7 cases complicated by injury to the small intestine be subtracted, the mortality for pure colic wounds is reduced to 38·7 per cent. The terminal results are unknown, but at the date of transference in 13 cases a fæcal fistula persisted, in 9 a sinus discharging pus, and only 5 returned soundly healed. In 6 cases the fæcal fistula was actually an open colostomy needing a further operation for permanent closure.

As to the immediate cause of death, reference has already been made in the general section to the observation that colic injuries are followed by a more intense infection and rapid local reaction, hence a general peritonitis was developed in only 15 out of 25 fatal cases, and seven of these were complicated by wounds of the small intestine which is as a rule followed by a general infection. It is interesting to note in this respect that in one fatal case where a wound of the pelvic colon and of a pelvic coil of small intestine were concurrent, the reaction following the colic wound was sufficient to produce local adhesions and confine the peritonitis to the pelvic cavity. In two other cases the cause of death was general septic absorption, a main feature being the development of septic broncho-pneumonia or a purulent pleurisy.

The 56 cases were distributed as follows: Ascending colon 30 (including 9 of the cæcum), of which 12 died, mortality 46·4 per

cent; transverse colon 7, of which 3 died, mortality 42·8 per cent; descending colon 19, of which 11 died, mortality 52·6 per cent.

One general observation made by Lieutenant Henry, in the autopsies performed on patients who died as the result of wounds of the colon, has been the constant presence of anaerobic infection of the liver and blood-stream; the post-mortem appearances described in Case 3, already detailed, sufficiently illustrate this point. At what date before death the generalization of the anaerobes takes place, or whether a rapid spread of the infection takes place immediately after death, it is difficult to determine, but that it is not usually diagnosed clinically seems in favour of the latter occurrence. This view is supported by the fact that where the extraperitoneal tissue is infected by anaerobes of the *perfringens* type, a rapid gaseous cellulitis, accompanied by great abdominal distension, is usually observed, and this is not the case in the majority of the cases of fatal wound of the colon. The constant post-mortem presence of a general extension of anaerobic infection noted in cases of wound of the colon is of great importance from another point of view, since it strongly suggests that the source of primary infection in all cases of gaseous cellulitis is human fæces, and not the highly manured soil on which the onus has been so frequently thrown. A gaseous cellulitis developing during life may give rise to great difficulty and confusion in diagnosis, and a few examples may be given: (1) A patient with a wound passing from low in the left loin to the right iliac fossa was paraplegic from an injury to the cauda equina. On the seventh day great abdominal distension suddenly developed, accompanied by vomiting and colliquative diarrhœa. The patient was greatly distressed and died within twenty-four hours. At the post-mortem examination the only injury to the bowel consisted of bruising of the posterior aspect of the cæcum, together with considerable retroperitoneal hæmorrhage. (2) A more rapidly fatal but less acutely progressing instance was seen in a patient with a wound traversing the left ilium. After the first day frequent vomiting accompanied by diarrhœa commenced and continued until death on the fifth day. On the fourth day the patient was pale and in great distress. The bodily temperature was subnormal, the pulse 103 very small, the hands cold, and respiration was of the grunting type. The abdomen was much distended, tender and immobile. From the position of the wound an injury to the pelvic colon was suspected. At the post-mortem examination no injury to the bowel was discovered, but extensive retroperitoneal gaseous cellulitis. (3) A patient with a bullet

wound entry just above and to the left of the pubic symphysis had definite signs of an extraperitoneal wound of the bladder. On the fourth day a suprapubic cystotomy was performed to drain the bladder and evacuate the extravasated urine. Four days later the abdomen became distended, and the man suddenly passed into a state of collapse and died. At the post-mortem extensive gaseous cellulitis of the anterior abdominal wall was found to have developed. The development of retroperitoneal gaseous cellulitis has also frequently followed wounds of the kidney and liver.

These cases are interesting as contradicting an assertion made in the early stages of the campaign, when massive gangrene of the limbs was common, that gaseous cellulitis involving the trunk did not occur, except as an extension from the limbs. This assertion was founded on what is still an undoubted fact, that the anatomical arrangement of the walls of the chest and abdomen is not such as to favour the development of extensive areas of gangrene such as is seen in the limbs. Subsequent experience has afforded abundant evidence that gaseous cellulitis is not uncommon either in the abdomen, the chest, or the head, the only marked feature in these positions being the comparatively late date of development of the signs. Many of the cases of infection of the great body cavities resembled in their course the sudden late exacerbations of gas formation seen in the limbs after a latent period in which the patient has appeared to be doing well.

With regard to the distribution of the wounds in cases arriving at the general hospitals and its influence on prognosis, it will be noted that the ascending colon and cæcum were the parts most frequently the seat of injury, also that wounds of this segment of the large intestine furnished the largest proportion of recoveries. The explanation of this fact is obvious: the ascending colon is an exposed segment, it is also fixed, and moreover may readily be wounded without concurrent injury to the small intestine. The fact that it is so situated as to readily become adherent to the wall is also a highly favourable moment. Wounds of the transverse colon may be equally frequent, but they are less often met with in general hospitals and are much more commonly fatal, since isolated injury is less common. This portion of the bowel is freely movable, and the spread of infection or extravasation of contents when it occurs, is into the area occupied by the small intestine whose motility serves to diffuse the infection widely. The actual mortality in the cases included in the series of seven cases is low, 42·8 per cent, and it includes one patient operated upon during the first twenty-

four hours, but the duration of life of the fatal cases was below the average (two, three and four days respectively). On the other hand, the surviving cases were each of a somewhat special nature: In one the gut protruded freely (not an uncommon event in the case of the transverse colon), and was treated as an ordinary transverse colostomy by tying in a tube; in another the wound was caused by a spent bullet which entered over the hepatic flexure, retaining only sufficient force to enter the bowel, whence it was shortly discharged per anum, and a third was originally looked upon as a wound of the abdominal wall, a fistula opening on the third day, and discharging no more fæces after the sixth.

The greater mortality attending wounds of the descending colon and sigmoid flexure and the smaller number who survive to reach the general hospitals is explicable on grounds of the same nature. This segment of the gut either lies deeply covered up by coils of small intestine, or in its lower part projects freely into the area occupied by the small intestine: Again, it is narrow compared with the more capacious cæcum and ascending colon. Among the eleven fatalities included, in five the small intestine had also suffered perforation; with regard to the protection afforded to the colon by the bony skeleton, it may be remarked that this is really a source of danger, since the addition of a comminuted compound fracture of the pelvis or ribs is a most undesirable complication of a fæcal fistula.

Clinical Signs and Diagnosis.—Patients who die as the result of isolated injuries to the colon at the field ambulances succumb either to hæmorrhage or rapid septic absorption, due to the severity of the injury and the free escape of infective material. Those that survive to reach the general hospital, a much larger proportion than is the case with patients who have lesions of the small intestine, present a series of clinical symptoms and signs which are very distinctive.

The primary signs may not greatly differ from those accompanying any abdominal injury, and the same variation may occur in the initial symptoms as observed in the case of the small gut. The special signs are the common early escape of fæces when the wound is large and the occasional occurrence of melæna or the development of cellular emphysema. Beyond these the position of the wounds of entry and of exit, if it exists, is an important diagnostic aid.

The characteristic signs develop later and are dependent on the marked tendency of these lesions to become localized already remarked upon.

The development of the fæcal fistula should be first dealt with because in the case of extensive lacerations this may be an early sign. In the cases which reach the general hospitals, however, it is a much later one, occurring on the fourth or fifth day in accordance with the general observation that early escape of contents is not a common result of gunshot wounds of the intestines. In small wounds it is common for the escape of fæces by the fistula to correspond in date with the first action of the bowels, while the amount of fæces escaping depends on the actual size of the intestinal opening and to a lesser degree on the height of the injury. Naturally a wound of the cæcum is likely to furnish a much freer flow than one of the sigmoid flexure. Prior to or concurrently with the date of commencement of the escape of fæces may be the development of cellular emphysema; this latter is usually accompanied by the genesis of a coli cellulitis, depends on the length and tortuosity of the wound track, and is far more common in wounds of the retroperitoneal segment of the bowel.

The extravasation of fæces in the tissues may be very extensive, especially in the retroperitoneal tissue of the loin, but it occasionally spreads freely in the anterior abdominal wall; thus I have seen it spread from a fistulous opening in the left iliac region to a paramedian incision above the level of the umbilicus made for the performance of a transverse colostomy, or even down to the ankle. The latter observation deserves a more detailed description.

Case 1.—Under the care of Major Parsons. A man received a wound from a bullet entering just external to and below the level of the position of the gall bladder. The bullet passed downwards and lodged in the right iliac fossa.

When seen upon the fourth day at the general hospital a small amount of fæces was escaping by the aperture of entry. At the end of the week all discharge ceased, the abdomen looked normal, and the bowels were acting naturally. On the eighth day the patient commenced to complain of sciatic pain, and on the ninth considerable swelling of the back of the thigh was noted. The thigh was not discoloured, but pain and tenderness were very severe, and an incision was made through the hamstring muscles from which fæces escaped freely. In spite of the incision the extravasation extended down to the popliteal space and thence to the outer ankle, and although further incisions were made the patient succumbed to acute septic absorption. The fæces had entered the lacerated psoas and iliacus muscles above, followed the course of the psoas tendon to the lesser trochanter and thence

had travelled down the back of the thigh amongst the hamstring muscles. As will be recalled, a similar course of extension is related in Case 4 of a lesion of the small intestine, and I have seen one other colic injury in which the complication occurred. In all three instances the lesion was on the right side of the body.

A frequent occurrence when the wound is smaller is the development of a secondary fæcal abscess, while in the slightest and most fortunate cases a wound of the colon may be followed merely by a tender local intraperitoneal induration, which subsequently subsides without giving further trouble. In two of the cases included in this series bullets which had entered the hepatic flexure and the descending colon respectively were passed per anum, the patient exhibiting no serious signs whatever.

In concluding this section a case may be detailed shortly which illustrates well one of the sources of difficulty of diagnosing a colic injury.

Case 2.—A man was admitted on the fourth day after receiving a shell wound of the right buttock just above the level of the right trochanter. He was pale and ill, temperature 100° F.; pulse 100 of low tension, The tongue was furred and dry, the bowels confined. The abdomen was generally distended and immobile, and exceedingly tender in the left lower quadrant. A piece of shell case was localized as lying in the hollow of the sacrum. During the next five days little change occurred except that a definite local swelling developed in the left iliac fossa extending up to the level of the umbilicus. Meanwhile gas and brown fæcal-smelling fluid escaped by the wound of entry, and a wound of the pelvic colon was suspected.

On the ninth day the wound of entry was enlarged by Captain Mumford, and the piece of shrapnel removed through the gap which was present in the ilium. The operation was followed by an increase in the amount of discharge, which lost its fæcal odour, and steady decrease in the size of the abdominal tumour, and action of the bowels became regular. Ten days later the general condition had improved sufficiently to allow the patient to be transferred to England, and the diagnosis was revised to one of retroperitoneal hæmorrhage and secondary retroperitoneal gaseous cellulitis.

Treatment of Wounds of the Colon.—There is little to say regarding the early treatment of patients with wounds of the colon which reach the general hospitals, except to give a warning against the employment of enemata or too early purgation. The

mechanical disturbance attendant on the introduction of a quantity of fluid into the bowel constitutes a grave danger, and if any form of mechanical treatment is deemed necessary the stimulus of a glycerine injection should be tried. Purgatives by mouth should be withheld for the first seven days, and even then it should be remembered that the date of the action of the purgative and the establishment of a fæcal fistula will often coincide. At an earlier date the more serious accident of a peritoneal extension may follow the administration of an active purgative. Small doses of calomel, followed by castor oil, is the best form of purgation to employ. Later paraffin, as causing little peristaltic action, may be useful.

One case only has come under my observation in which a successful primary operation had been performed for a complete division of the ascending colon, and in this a secondary abscess needed incision in the general hospital. Bearing in mind the comparatively good prognosis in colic wounds, primary operations for suture should be selected with much care, and those in which a simple small perforation is suspected cannot be said to demand operation at all.

The performance of a proximal colostomy stands on another footing. It is suitable for all cases in which a large wound is present and the danger of general septic absorption exists. Especially is this the case when a large exit wound is complicated by a comminuted fracture of the pelvis. Unfortunately in the majority of patients with colic wounds who survive the primary dangers of the accident the lesion is situated in the ascending colon; there a complete artificial anus is often impossible to make, especially when retroperitoneal extravasation of fæces is present, since under such circumstances division of the peritoneum fixing down the ascending colon cannot be undertaken. Still even in these cases the establishment of a cæcal anus may lower the intra-intestinal pressure to such a degree as to prevent further spread of the extravasation. When feasible a transverse colostomy possesses some advantages, as it is not only easy to establish a complete artificial anus, but also one comparatively easy to close.

The immediate results obtained in ten cases in which a temporary colostomy has been performed are good, thus seven recoveries and three deaths. It should be added that in the three cases in which death followed the operation was performed too late; in each the symptoms of general septic absorption were severe and all three patients died with lung complications. On the other hand, the seven cases which recovered all returned to England

with the colostomy still working, and needing a second operation for its closure. The result in preventing the development of serious general septic infection was very striking, and except in the case of small wounds which may heal readily, a temporary colostomy is the proper mode of treatment, both from the point of view of preventing general infection and from that of more rapid healing of the original wounds.

WOUNDS OF THE RECTUM.

Twenty-two cases of wounds of the rectum are included in the series, in 6 the wound involved the peritoneal cavity. In 15 of the series the injury was inflicted by a bullet, in 3 by a fragment of shell, and in 4 no record has been kept. In a large majority of the cases the wound of the rectum was accompanied by a comminuted fracture or perforation of the bones of the pelvis, in 1 by a comminuted fracture of the head of the femur. In 8 of the cases 1 of the wounds was situated in the buttock, in 3 instances both buttocks were perforated, in 2 cases the sacrum alone was fractured. In 6 cases there was an associated wound of the bladder, in 1 the urethra was torn, and in 1 a second intestinal wound was present in the sigmoid flexure.

The immediate cause of death was in 6 cases general septic absorption, and in 2 general peritonitis. Among the fatalities the average length of life was about 10 days. The actual mortality in the 22 cases was 8, or 36·3 per cent, but this mortality is perhaps higher than was actually the case, for in 4 instances minor wounds of the rectum from the ischio-rectal fossa were successfully treated by division of the sphincter ani, and sent home with only a small wound to heal. I have not included the latter because they are manifestly injuries of a totally different degree of severity.

Clinical Signs and Diagnosis.—The diagnosis of a wound of the rectum is usually easy, but the early signs are not constant. The most typical of these are hæmorrhage and incontinence, the latter especially in wounds involving the sacrum, but it is a sign independent of rectal wound and may depend on a nerve lesion alone. Diarrhœa was observed once; as a rule constipation is present, but fæces escapes at an early date from the wound. The establishment of a fæcal fistula takes place earlier than in wounds of the colon, and earliest of all when a wound of the bladder co-exists with that of the rectum. A wound of the rectum may give rise to practically no signs, thus in one case included in the

series a bullet entered above the pubes and was retained. No special signs were observed, and on the fourth day the bullet was passed with a motion obtained by the administration of an enema and the patient was later sent home well.

Treatment.—A serious wound of the rectum with fæcal discharge from a track through the pelvis needs a temporary colostomy. Of eight cases so treated fifty per cent were sent home in good condition and the remainder died. If the wound involves only that portion of the rectum situated in the ischio-rectal fossa and the sphincters are intact, the latter should be incised as in an ordinary fistula, and the wound usually heals without further difficulty.

The most troublesome cases to deal with are those in which both bladder and rectum are involved. Some of these injuries may heal spontaneously, but the course is slow, and always liable to complication by secondary suppurations. The wisest course is to perform a colostomy and await events, and under these circumstances a transverse colostomy offers obvious advantages as being as far removed as practicable from the site of a possible cystostomy which may need to be performed when the artificial anus is healed and under control. The two operations should not be performed at the same date, and the cutting off of the flow of fæces is the more important primary step, both as regards the external wound and the wound in the bladder.

THE TOXICITY OF EMETINE.

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This paper has been written with the object of putting before the medical officers serving with the Army what little information we have been able to collect on the toxicity of emetine. As a preface, however, we have introduced some notes on the meaning of the term emetine, since this expression has been used to designate principles of different degrees of purity obtained from ipecacuanha, and we also give a short description of the chemical and physical properties of emetine hydrochloride, much of which is drawn from recent work and has not yet passed into text-books on materia medica.

The meaning of "Emetine."—The term emetine was first employed in 1817 by Pelletier and Magendie [1] to describe a principle which they isolated from ipecacuanha root in a yield of sixteen per cent. Since the root does not contain more than about three per cent of total alkaloids, this principle must have contained much non-alkaloidal material. Later on, Pelletier prepared a pure alkaloidal principle from the root in a yield of about one per cent. This preparation, which contained the total alkaloids of ipecacuanha, was also called emetine. We shall call this substance crude emetine in the following notes in order to distinguish it from the individual alkaloid of the same name. Previous to 1894 the emetine used in medicine consisted of the total alkaloids of ipecacuanha, but in that year Paul and Cownley [2] showed that crude emetine consisted principally of two individual alkaloids which they named emetine and cephaeline. They attributed to these alkaloids the formulæ: $C_{30}H_{44}O_4N_2$ or $C_{15}H_{22}O_2N$ and $C_{28}H_{40}O_4N_2$ or $C_{14}H_{20}O_2N$ respectively. A few years later Hesse [3] suggested the slightly altered formula $C_{30}H_{42}O_4N_2$ for emetine, and $C_{28}H_{38}O_4N_2$ for cephaeline. For many years no further important advance was made in our knowledge of the chemistry of these alkaloids, but the striking clinical records of Rogers with emetine hydrochloride given hypodermically in amœbic dysentery stimulated several chemists to new researches on the subject, and their results were published in 1913-1914.

Hesse [4] confirmed his formula for cephaeline, but withdrew his formula for emetine, $C_{30}H_{42}O_4N_2$, substituting for it the formula $C_{30}H_{40}O_5N_2$. Neither of these formulæ for emetine is correct, for Carr and Pyman [5] showed that emetine is the mono-methyl ether of cephaeline and, therefore, contains one carbon atom and two hydrogen atoms more than cephaeline. They confirmed Hesse's formula, $C_{28}H_{38}O_4N_2$ for the latter alkaloid, and it is now clear that emetine must have the formula $C_{29}H_{40}O_4N_2$. Their analyses of the base and several of its salts and derivatives confirmed this formula.

The Properties of Emetine Hydrochloride.—Emetine, $C_{29}H_{40}O_4N_2$, combines with acids to form salts which contain one equivalent of the base to two of the acid. Emetine hydrochloride, $C_{29}H_{40}O_4N_2$, 2HCl, crystallizes from alcohol or water in white, woolly needles which, after drying in the air, contain from three to seven molecules of water of crystallization. It is readily soluble in warm water, one part dissolving in about four parts of water at the body temperature (37° C.). At lower temperatures it is more sparingly soluble, one part of the salt dissolving in about seven parts of water at 25°, nine parts at 20°, eleven parts at 15°, and thirteen parts at 10° C. It is much less soluble in dilute hydrochloric acid than in water, and is consequently precipitated from strong solutions by this reagent. Emetine hydrobromide is much less readily soluble than the hydrochloride, one part dissolving in about fifty parts of cold water. It is, therefore, less suitable for hypodermic administration. Aqueous solutions of emetine salts yield a precipitate of the sparingly soluble base when mixed with alkalies; they also give precipitates with the usual alkaloid reagents. Aqueous solutions of emetine salts can be sterilized without becoming decomposed. Emetine and its salts do not suffer any chemical change by the action of acids or alkalies at the body temperature. There is no reason to believe that emetine is attacked by the gastric juice and the practice of coating compressed products of the drug with keratin, to ensure that the drug does not come into action in the stomach, has the object of avoiding nausea, and not that of protecting the drug from decomposition by the gastric juice.

The Toxicity of Emetine.—In view of the present method of administering emetine the questions of practical importance are: What is the toxicity of emetine hydrochloride when administered hypodermically to man? And how is the toxic action manifested?

Little information is to be found in the literature on these specific points, for several reasons. In the first place, this mode of treatment is comparatively recent, dating only from 1912; secondly,

the doses employed are usually well below those required to produce toxic symptoms; and, again, there is not yet sufficient evidence to show whether certain symptoms, noted after the treatment of dysentery with emetine, are due to the disease or the remedy. Whilst little has been published on the toxic action of emetine hydrochloride given hypodermically to man, a considerable amount of work has appeared on the effects of administration of crude emetine to animals, and some accounts of the effect of pure emetine hydrochloride on animals are also to be found. There are also a few records of the effect of pure emetine hydrochloride on man. We give a short account of some of these below.

Action of Emetine on Animals.—Lowin, who performed experiments with pure emetine, gives an account of the earlier work with crude emetine, and reproduces Foulkrod's [6] summary of the latter's results with crude emetine administered to rabbits, which, it is well known, are unable to vomit:—

(1) After local application, emetine causes gradual loss of ability to functionate on the part of nerves and striped muscle, and, after long application, a return to the normal condition is no longer possible. After direct application to the brain and marrow no action was noticeable.

(2) It causes, on injection into the blood, diminution of the arterial pressure owing to paralysis of the heart, and

(3) At first acceleration, then slowing of the heart-movements, the latter from the same cause.

(4) It paralyses those inhibitory fibres of the vagus which belong to the heart.

(5) By its action on the brain it causes sleep and coma.

(6) The convulsions caused by emetine are of spinal origin, so also is the suppression of reflex action.

(7) Vomiting after emetine is the result of local action on the stomach.

(8) Slowing of the respiration after emetine takes place also after cutting the vagus.

(9) Voluntary muscle remains intact in the usual form of emetine poisoning, although its contractability is destroyed by direct contact with a solution of the alkaloid.

(10) Emetine is absorbed unchanged, and is eliminated partly by the kidneys and partly by the mucous membrane of the stomach and intestines.

(11) Salivation is caused by local irritation of the sensory nerve endings in the cavity of the mouth.

(12) After introduction into the mouth, blood, or subcutaneous

tissue, it causes albuminuria, and in ipecacuanha-poisoning the liver contains more sugar than the normal amount.

(13) A direct action on the blood cannot be observed.

(14) It does not act on the pupils.

Wild [7] was the first to carry out physiological experiments with pure emetine hydrochloride and we shall have occasion later to refer to his experiments on man. He found that twenty milligrammes of emetine hydrochloride injected into the jugular vein of a cat caused death by failure of the heart in forty-five seconds. Emetine produced slowing, weakening, and diastolic arrest of the frog's heart; it was also found to be a muscle poison.

Lowin [8] carried out a long series of experiments on animals with emetine hydrochloride, and his results may be summarized as follows :—

(1) *Action on Blood.*—Emetine hydrochloride solution 1 in 1,000, added to the blood of birds or mammals diluted 1 in 100 with saline, causes neither hæmolysis nor the formation of methæmoglobin. With a ten per cent blood-saline mixture, however, emetine causes a certain hæmolytic action.

(2) *Action on a Skinned Frog's Leg.*—Results show that the action of emetine on muscles and peripheral motor nerves is inconsiderable.

(3) *Action on the Frog's Heart in Williams's Perfusion Apparatus.*—The heart is paralysed. Irregularities occur in the mode of contraction and in the beat. Ventricle contraction becomes more peristaltic. Emetine must be regarded as a heart-poison; it appears to paralyse the muscles and excito-motor nerves of the heart.

(4) *Local Action on Mucous Membrane and Subcutaneous Tissue.*—A 1 in 500 solution introduced into the conjunctival sac causes violent inflammation. Injection into subcutaneous tissue, however, causes no inflammation worth mentioning. We have, therefore, the remarkable result that it has only slight effect on nerves and muscles, and that the subcutaneous tissue is quite indifferent to it. On the other hand, the mucous membrane of the conjunctiva is very sensitive, and so also is the mucous membrane of the stomach.

(5) *General Effect on Cold-blooded Animals.*—Tested on frogs (*Rana esculenta*), the general effect is a gradual general paralysis, which is not preceded by symptoms of irritation. The toxic dose is large, often over 0·02 gramme, for emetine hydrochloride.

(6) *General Effect on Mammals.*—Lowin's results with pure emetine agree in the main with those of previous workers with crude emetine. Experiments were carried out with rabbits, hedgehogs, guinea-pigs, doves and dogs, and the toxic dose of emetine

hydrochloride was found to be 0·032 gramme per kilogramme weight of the test animals. The animals died of paralysis of the heart.

We are indebted to Dr. H. H. Dale, F.R.S., for permission to publish the following results, which he obtained at the Wellcome Physiological Research Laboratories in 1913: Guinea-pigs of 200 to 220 grammes were killed by 6 milligrammes of emetine hydrochloride given hypodermically, but not by 4 milligrammes. Vomiting and purging was caused in cats by doses of 20 milligrammes of emetine hydrochloride given hypodermically. Dale's figure for the toxicity of emetine agrees with that found by Lowin.

L. Rogers [9], however, gives the following results, indicating that the toxic dose of the drug is about 0·014 gramme per kilogramme.

Animal	Equivalent dose for a 70-kilo man	Method of administration	Result
Guinea-pig ..	5 grains per 70 kilogrammes ..	Hypodermically ..	No symptoms.
" ..	10 " " " ..	" ..	"
Rabbit ..	5 " " " ..	" ..	"
" ..	10 " " " ..	" ..	"
" ..	15 " " " ..	" ..	Died in ten to eighteen hours.
" ..	4 " " " ..	Intravenously ..	Died in one minute with convulsions.
Monkey ..	5 " " " ..	Hypodermically ..	No symptoms.
" ..	10 " " " ..	" ..	"
" ..	15 " " " ..	" ..	Died in half an hour with convulsions.

Rogers comments that as the lethal dose was very much the same for both rabbits and monkeys it is probable that the results obtained will apply fairly accurately to man.

Cushny [10] gives a useful summary of the action of emetine on animals, from which we quote the following passages:—

"When administered internally emetine has a bitter, acrid taste, and produces a copious salivary secretion, followed later by nausea and vomiting. The drug is generally largely eliminated by vomiting, so that no further effects are observed.

"The nausea and vomiting are accompanied by the usual symptoms—muscular weakness and depression, increased secretion of saliva and of mucus by the glands of the throat and respiratory passages, often perspiration and generally temporary acceleration of the pulse.

"Quantities which are too small to provoke vomiting induce prolonged nausea with increased mucous secretion along the the respiratory passages and some perspiration." . . .

"Emetine possesses a powerful irritant local action." . . .

"The emetic action is, undoubtedly, due to ipecacuanha irritating the stomach, and is thus a further example of its specific action on the mucous membranes." . . .

"When large doses are injected hypodermically, emetine induces nausea, vomiting and purging, and blood is frequently voided in the stools, a condition of collapse follows, and the animal generally dies of exhaustion in the course of a few hours after the onset of the symptoms. Very large quantities injected subcutaneously or intravenously may fail to elicit vomiting, but the collapse symptoms appear, and after some weak convulsive movements the animal dies of cardiac failure."

In concluding these abstracts of work with animals, we may draw attention to a useful summary by Dr. Dale in the "Practitioner's Encyclopædia of Medical Treatment," edited by W. Langdon Brown and J. Keogh Murphy, which has recently been published.

The Toxicity of Emetine to Man.—Wild [11] has given an interesting account of the effect of pure emetine hydrochloride administered to himself by the mouth:—

"A dose of 5 milligrammes ($\frac{1}{12}$ grain) produced either no noticeable effect or after the lapse of half an hour slight nausea, giddiness and salivation; pulse tracings showed lowering of tension during period of nausea, and in one hour and a half recovery was complete. Doses of 10 milligrammes produced more similar and marked effects with retching, but in myself no actual vomiting. With a dose of 15 milligrammes ($\frac{1}{4}$ grain) giddiness, nausea, and retching came on in twenty-five minutes, and rapidly increased, accompanied by great salivation and watery secretion from the nasal mucous membrane; in forty-seven minutes vomiting occurred and again a few minutes later. The nausea improved after the vomiting, but the feeling of illness and exhaustion continued and remained some time after the nausea had entirely disappeared, some two hours from the administration of the drug. The pulse tracings showed marked lowering of the arterial tension, and this was at its maximum some time before vomiting occurred; it was partially recovered from before vomiting, but remained below the normal for some hours. About two hours after the administration a distinct increase of intestinal peristalsis was noted, with borborygmi and a desire to empty the bowels; this culminated in a loose motion. There was no noticeable effect upon the skin or upon the secretion of urine, nor did the vomited matter contain excess of bile."

Zepf [12] carried out experiments on human beings in two directions, (1) giving small doses of emetine per os to phthisis patients, and (2) giving suppositories of emetine to lunatics.

(1) In the first series of experiments, it was found that in doses up to 0·008 gramme of emetine, and given up to three times a day by the mouth, emetine did not cause an expectorant action, judged by the amount of expectoration, nor could any increased defæcation be noted with certainty. The most frequent complaints, eliminating those probably due almost entirely to the disease, were of increased salivary secretion, inclination to vomit, tickling in the neck, burning in mouth and throat and pressure in the stomach.

(2) In the second series of experiments, it was found that the rectum did not react to the irritation caused by emetine so as to bring about evacuation, but the drug caused inflammation with pain and bloody stools.

Zepf's main conclusions are:—

(1) Emetine when applied locally is irritating to both ends of the digestive tract.

(2) It causes loss of appetite, stomach troubles, and headache.

(3) It causes nausea followed by emesis.

(4) It has an action on the upper respiratory passages.

(5) It has a depressing action on the central nervous system. He did not study the action on the heart.

Cushny [13] states that in man vomiting has followed the hypodermic injection of four grains of emetine, but one grain administered in this way has no such effect.

Clinical Observations.—A medical officer from the West Coast of Africa has informed one of us that having undergone intensive treatment with emetine, receiving nineteen injections of one-third grain given three times a day, he suffered from an intense salivation, which began quite early in the course, and a painful stiffness of the muscles, which commenced about the fifth day. It is possible that this was an example of special idiosyncrasy to the drug, though little, if anything, is known about this aspect of the question. He himself had not met with any case in which emetine had been responsible for death.

One observer has reported that vomiting, colic, abdominal cramp and collapse followed by death within an hour and a half occurred in the case of a patient who had taken a large amount (quantity not stated) of ipecacuanha wine.

In view of some of Lowin's observations on animals it is interesting to note that those employed in the preparation of emetine find it very irritating to the conjunctivæ and skin. It

often produces a severe eczema. So far as is known those who handle the drug do not suffer from any constitutional symptoms.

Medical officers treating cases of amœbic dysentery with emetine will do well to remember :—

(1) That emetine is a very costly drug.

(2) That if it is going to do good its beneficial action is generally quickly apparent.

(3) That it is useless, unwise and wasteful to subject patients to repeated, long-continued courses of the drug. We know very little about the possible cumulative effect of emetine. There may be none, but in any case two short courses of the drug in appropriate doses will *usually* suffice to cure a case of amœbic dysentery. This would necessitate a primary administration in all of from ten to fifteen grains and accords with the experience of Low [14] in his recent article on the treatment of amœbic dysentery.

(4) That emetine may itself produce and keep up a certain degree of diarrhœa and that it is important to distinguish this drug-produced diarrhœa from that caused by intestinal disease.

It is evident from this brief review of the matter that more information regarding the toxicity of emetine is certainly required. It is therefore gratifying to be able to record that Dr. H. H. Dale, F.R.S., Director, Department of Bio-chemistry and Pharmacology, Medical Research Committee, has undertaken a special research on the subject, which will be made public in due course [15].

It may be expected that valuable clinical information will soon be forthcoming from medical officers serving with the Mediterranean Expeditionary Force, who have had great opportunities of observing the effects of emetine administration in cases of amœbic dysentery both complicated and uncomplicated. It is to be hoped that such medical officers will not hesitate to place their experiences on record.

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[15] A preliminary note by Dr. Dale has appeared since these notes were written; compare *Brit. Med. Jour.*, December 18, 1915, p. 895.

THE TREATMENT OF "CONCUSSION BLINDNESS."

By Captain A. W. ORMOND.
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One of the principal ocular features of the present War is the number of cases of functional blindness due to the violent explosions caused by high explosive shells, bombs, hand grenades, &c. These cases may or may not have sustained definite organic injuries, but the clinical symptoms characterizing their functional nature are very clearly marked.

Usually the patient has been rendered unconscious by an explosion in his close vicinity, and on regaining consciousness he finds that he is unable to see. When examined he presents the following symptoms: The eyes are kept closed, the lids may be frequently "fluttered," or, as one man stated, "he could not keep his eyes from twinkling." On attempting to open the lids the patient resists forcibly by means of his orbicularis; when this is overcome to a sufficient extent to see the globes, they are found to be rolled forcibly upwards, and the pupils are always kept covered by the lids; he has great difficulty in looking downwards, and complains of pain and photophobia, and shows marked fatigue as a result of the examination. In some cases I have noticed an acceleration of the pulse-rate and also perspiration. The photophobia is not, however, really influenced by light, as the condition does not diminish in very subdued illumination; these patients never move about as blind men would, they invariably avoid hurting themselves; but all the same they never relax, even if watched for weeks at a time, the groping action of people with extremely defective sight, and judged by every test they maintain this condition indefinitely, and are undoubtedly psychically blind; the pupils react normally, and the fundus shows no definite change. There is no difficulty in differentiating them from malingerers, as they pass through long periods of real mental distress and serious discomfort. These cases vary enormously in severity; some recover rapidly, others seem to go on indefinitely if not treated or treated unsuccessfully. Any lack of recognition of the condition in the early stages enormously prejudices the prognosis. One case having been told that he was blind remained so for several months, whereas, probably, if it had been recognized earlier that he was

not blind and would recover, he would have done so much more rapidly.

Early in the War I treated these cases in several ways, all with disappointing results; some of the slighter cases certainly did recover, but they recovered in spite of treatment and not on account of it. The main principles on which I worked were rest, tonics, deprivation or punishments, such as abstention from tobacco, &c., confinement to bed or in isolation rooms, persuasion, encouragement, counter-irritation, talking, &c., but all these means were comparatively ineffective until suggestion and hypnosis were tried. In August, 1915, I thought it would be advisable to try suggestion, although I had a strong personal prejudice against its use; but when later on these cases still remained on my hands, I consulted with Major Hertz and we decided to start the hypnotic treatment. The method employed was to have the men singly in a darkened room, quiet, and resting in the most comfortable arm-chair the ward would provide. They were instructed as to what was to be attempted, and no demur was ever made by any of them, but on the contrary, after the first experience, they were always eager to continue the treatment. The patient had his eyes closed of course, so that the assistance of light and fixation could not be obtained, but he was told to think of something pleasant and agreeable, not to take the slightest notice of the operator, and to relax his mind by attempting to stop all incoming thoughts and to make his mind, as far as possible, a blank; we then used the usual methods of inducing hypnosis. In some cases—for example, Private B.—the hypnotic condition was obtained, but not in all, and I do not think it at all necessary to obtain complete unconsciousness; the main thing to be arrived at is to obtain a relaxation of the patient's mind and his muscles, and to overcome his unconscious resistance.

The treatment is carried on thus for a few minutes, and having obtained the sleepiness or light hypnosis necessary, the patient is subjected to a forcible suggestion from the operator, who reiterates the patient's ability to see and to open his eyes, and to assert very vehemently that he is not blind as he imagines, but that his eyes are perfectly sound and that he *can* see.

The results have varied considerably as to rapidity of recovery, but all have shown marked improvement, the most drastic being that of Private B. (Case 1), the most resistant being the deaf and blind man, Corporal W. (Case 3). Cases of this nature have been constantly arriving from France and Gallipoli, but I here

insert the notes sent to me by Major Hertz immediately previous to his departure for Alexandria, as they were the earliest ones with which we dealt and are quite typical, and in all of them, except in the last case, Major Hertz collaborated with me in their treatment; they, however, only represent a small proportion of the total number of cases.

NOTES OF CASES BY MAJOR A. F. HERTZ, R.A.M.C.

Private B., aged 22, was looking over a parapet on July 18, 1915, when a shell struck the sandbags in front of him. He remembers the sand being thrown up into his eyes, and falling back so that he knocked his head. He remained unconscious for twenty-four hours. When he regained consciousness he found that he was completely blind, except that he could just distinguish light from darkness with his left eye. His eyes felt very sore, and his eyelids were constantly moving up and down. He was partially deaf and had a severe headache. His hearing soon returned and the headache rapidly improved, but the condition of his eyes had not altered when I first saw him with Captain A. W. Ormond on September 17. He was quite blind, and there was a constant flicker of his eyelids, which were kept almost closed. On forcibly opening his eyes they were found to be turned so far upwards that it was difficult to see even the iris. A few fragments of sand were still embedded in the conjunctiva, but not in the cornea; there was no inflammation present. The patient was easily hypnotized, and whilst asleep he was told that he would be able to see when he woke up. The moment he woke the suggestion was repeated very forcibly, and his eyes were held open. He cried out that he could see, tears ran down his cheeks, and he fell on his knees in gratitude, as he thought that he was permanently blind and believed that his sight had been restored by a miracle. When seen again on September 20, the external appearance of his eyes was normal, and he said that he was able to see as well as he had ever done. Captain Ormond, however, found that there was some opacity of the vitreous of the left eye, the result of a hæmorrhage from a retinal vessel, which had ploughed its way forward; this was doubtless a result of injury at the time of the explosion. There has been no return of symptoms, and the patient was well in every way when I last saw him on September 30. His vision was $\frac{6}{6}$ in the right eye and $\frac{6}{36}$ in his left.

Lance-Corporal H. had an attack of blindness, resulting from conjunctivitis, caused by a sandstorm when in Egypt early in

1915. He recovered from this after ten weeks, and six weeks later went to the Dardanelles. On July 12 a shell struck a sandbag immediately in front of him, and the sand flew into his eyes. He did not lose consciousness, but his sight gradually became more and more deficient until, at the end of ten days, he was only just able to distinguish light from darkness. Very slight improvement occurred spontaneously, but his condition, when seen on September 17, was identical with that of Private B., a few pieces of grit being still embedded in his conjunctivæ, although there was no inflammation. He was easily hypnotized, but there was very little improvement at the moment. Considerable improvement, however, occurred during the next three days. He was hypnotized on three more occasions; he could see perfectly well on September 30, but still had some photophobia and wore dark glasses, as he could not avoid constantly blinking when they were removed. He was therefore hypnotized yet again, and it was suggested to him that the photophobia and blinking would now cease. The result was completely successful, as all symptoms had disappeared by October 4, although no attempt had been made to remove the grit from the conjunctivæ.

Private C., aged 20, was rendered unconscious for a few minutes as a result of the explosion of a shell near him on August 21 in the Dardanelles. Some of the powder was blown into his eyes, which were very sore when he regained consciousness, although he was still able to see quite well. During the next twenty-four hours his vision became more and more impaired. The powder was removed from his eyes when he was taken on board the hospital ship, and his eyes were bandaged. After a few days he thought he would be able to see quite well if the bandages were removed, but the medical officer in charge told him that it would be dangerous to do so. During the voyage home he was not allowed to remove the bandages, and he became more and more convinced that this must be because the medical officer thought he was blind. The bandages had not been removed when he was admitted into the hospital on September 25. When they were removed he was found to be in exactly the same condition as Private B. and Lance-Corporal H. He could distinguish light from darkness but was unable to see anything, and he kept his eyes turned up and his eyelids closed and constantly contracting. On September 27 he was hypnotized by Captain Ormond, after which he found he could see quite well, but the light still worried him and the blinking continued, though to a diminished extent. He completely recovered subsequently and returned to his depot.

Lance-Corporal S., aged 29, was knocked over by a high explosive shell in the Dardanelles and remained unconscious for a considerable time. On coming round he found he could only distinguish light from darkness; there was no smarting of the eyes, but he constantly blinked. He had a slight headache, but was otherwise well. He began to improve about September 10, so that he could recognize shadows passing in front of his eyes, but no further improvement occurred until he was hypnotized on September 18. There was very slight improvement as the result of suggestion at the time, but when seen again on September 20 he said that he was beginning to recognize objects, and the blinking was less marked than before, but he still kept his eyeballs turned upwards and his eyes almost closed. He was hypnotized again on September 20 and 25, and when seen on September 30 his sight was quite normal and the blinking had completely ceased. Subsequent retinoscopic examination revealed the presence of a considerable degree of myopic astigmatism in the right eye and mixed astigmatism in the left.

Corporal W. was signalling from a gun limber on April 28, when he was blown up and remained unconscious for six days. There was no external wound, but on regaining consciousness he found that he was blind, except that he could just distinguish light from darkness; he was also completely deaf and was unable to speak. He regained his speech in June, after a fortnight's treatment by hypnotism at Plymouth, but his sight and hearing remained unaltered. When I saw him on September 17 he could only be made to hear by shouting down an ear-trumpet; he kept his eyelids almost closed and constantly twitching, with his eyeballs turned upwards. He was extremely depressed, as he had been told by an aurist that he would never regain his hearing, as it was said that nerve deafness of such long duration could not improve, although the drums were intact. He concluded that the blindness would also be permanent. It was not easy to hypnotize him, as he was unable to see and all suggestions had to be shouted down his trumpet, but Captain Ormond succeeded in doing this at the first attempt. When seen on September 20, he said that his sight was distinctly better and he was able with difficulty to open his eyes. He was much more cheerful, particularly when we told him that his hearing would also return, as his auditory nerves were no more organically diseased than his optic nerves. On September 30 there was some further improvement, as he could see everything in the outer part of his left field of vision fairly well. He was

having a good deal of domestic worry, which no doubt prevented a more rapid improvement.

Private A. was unconscious for an hour after being blown up by a shell on August 7. He was unable even to distinguish light from darkness when he recovered consciousness, but he very gradually improved. He was admitted into the hospital on August 22, after which improvement was much more rapid, and by the middle of September he had quite recovered without any special treatment.

Lieutenant C., aged 20, had never used his left eye owing to an extreme degree of hypermetropia and amblyopia. When the other eye was covered he could only see very indistinctly with it, but in spite of this he managed to pass the medical examination when he entered the Army. He was hit on the left side of his head by the butt of a rifle in June and was unconscious for a few minutes. When he regained consciousness he at once noticed that he could not see at all with his left eye, although he had hitherto been in the habit of neglecting the blurred image he saw with this eye. On August 10, he received a slight wound to his left thigh, but he continued on duty. The wound had not completely healed and was still somewhat painful when, on August 23, he was blown up by a high explosive shell. When he regained consciousness he was being carried on a stretcher. The pain from his old wound drew his attention to his left leg, and he thought that he was unable to walk. When taken on the ship he found that this was the case, although there was no new injury of the leg. He also complained of severe pain above the left eye, which he kept covered by a shade, as he found that the least light greatly increased the headache; when the shade was removed he was unable to open the eye at all. For some time he was in an extremely excited condition and he slept very badly owing to nightmares. His eye was kept covered by a shade during his journey home from the Dardanelles. On his arrival in England, Mr. C. M. Ryley found that beyond the hypermetropia his left eye was normal, although he was quite unable to see anything with it. He was hypnotized on four different occasions. After the first he already slept better, the nightmares ceasing, and his headache was less severe. On the second occasion whilst still asleep the shade was removed from his eye, and he did not discover until half an hour after he woke up that it was no longer present, although up to that time he said that the least light caused extreme discomfort and spasm of the eyelid. After the third treatment he found he could see almost as well with his left eye as before he was hit on the head. Meanwhile

he was still unable to walk without crutches, although the wound in the leg had completely healed, and there was no physical cause to account for this. When he was hypnotized for the fourth time it was therefore suggested to him that he would be able to walk quite well, and he subsequently recovered entirely.

These cases are typical of many others that have been treated similarly; in fact, fresh cases of this same condition are arriving every week, and the "suggestion" treatment has not failed to give marked improvement in every instance. Up to the present we have had no failures, although Corporal W. (Case 4) has proved the most resistant, but his deafness and domestic trouble, together with the very unfortunate handling of the case in the early stages, have no doubt been responsible for this. Dr. Francis Brook very kindly undertook the later stages of his treatment for me, as owing to his greater experience in this work I thought he might obtain better results than I had effected. In November the man was given an anæsthetic, and suggestion was tried during the stage of semi-consciousness, with marked success, as the following day he opened his eyes voluntarily and has kept them open ever since. His speech and his sight having now returned, we hope that his hearing will not be long delayed.

Major Hertz and I hope that by publishing these cases greater attention may be drawn to these conditions, so that even if treatment cannot be applied at once, the cases may not be prejudiced unfavourably by injudicious handling.

It is probable that the presence of sand, grit, &c., in the conjunctival sacs of some of these patients may have been the cause of the "suggestion" of blindness, but they were not present in all cases, and recovery took place without them being removed; as a matter of fact, they were, when present, all embedded in the conjunctiva and did not produce any irritative symptoms at the time the patients were under treatment.

A SURVEY OF THE RESULTS OBTAINED DURING SIX MONTHS OF ENTERIC BACTERIOLOGY AT A GENERAL HOSPITAL.

By Captain T. H. JUST.
Royal Army Medical Corps.

The bacteriological diagnosis of the enteric group in war is of such importance that it may be of interest to record the methods employed and the results obtained in the laboratory of a general hospital.

The enteric division received the enteric group cases, and cases suspected of belonging to that group, from all the hospitals in the vicinity. The cases from which the statistics are compiled were those admitted to this general hospital during the six months January to June, 1915.

In order to prevent the spread of enteric fever, a bacteriological diagnosis should be arrived at as quickly as possible. Accuracy, however, must not be sacrificed to speed. It was thought, therefore, that the following method, which was carried out in practically every case, was the most satisfactory that could be adopted under the circumstances :—

Method Employed.

On admission to hospital the following examinations were carried out :—

(1) A blood culture.

(2) Examination of the fæces.

(3) Agglutination of the patient's blood, tested against *Bacillus typhosus*, *B. paratyphosus* A, *B. paratyphosus* B.

If the blood culture and the examination of the fæces proved negative, the examination of the fæces was repeated, the number of times that the fæces were examined depending on the individual case.

The urine was not examined as a routine measure owing to lack of time and laboratory space.

Technique of the Bacteriological Methods Employed.

Blood Culture.—Five cubic centimetres of blood were withdrawn from a vein with a syringe and mixed with five cubic centimetres of ox-bile in a test-tube. This was incubated at 37° C. and sub-

cultured on to an agar slope after twelve hours' incubation. If no growth had occurred the culture was again subcultured after twenty-four, forty-eight, seventy-two hours, or even later in some cases. In practically all cases the positive subculture was obtained in the first thirty-six hours, although in a few cases the growth was delayed. The growth from the agar slope was examined for motility. The culture was then tested for agglutination against known typhoid, paratyphoid A, and paratyphoid B sera of high titre. The agglutinations were done simultaneously and the microscopic method was employed. Dilutions of 1 in 400 and 1 in 800 were used, and in the majority of cases agglutination occurred immediately or within a few minutes with one of the specific sera, the motility of the bacilli being unimpaired or only slightly reduced in the other two sera.

In some cases no agglutination occurred; but on repeated subculture on agar agglutination with one of the specific sera ultimately resulted. This non-agglutinability of the original culture was more often found in cultures made from the stools than in blood cultures.

As a means of checking the agglutination results, the sugar reactions of the bacilli were tested—lactose, glucose, mannite, and litmus milk were used. The reactions against the other sugars were not tried in order to simplify the technique. Ox-bile as a culture medium was extremely satisfactory, being simple to work with, easy to sterilize, and giving a high percentage of positive cultures.

Fæces.—A small quantity of fæces was emulsified in five cubic centimetres of peptone broth, and one or two loopfuls spread over a MacConkey lactose plate. The plate was incubated twelve to twenty-four hours. Any pale colonies were examined for motility. Motile colonies were subcultured on agar. The subcultures were tested for agglutination against typhoid and paratyphoid A and B sera as in the case of the blood cultures. In some few cases the primary culture showed a pure, or practically pure, culture of the enteric group organism, and in these cases agglutinations were performed with the primary cultures. The sugar reactions were also tested.

Agglutination : Widal's Reaction.—In all cases the Widal reaction was done by the microscopic method, with young cultures of the live bacillus. The agglutination of the patient's blood was tested against *B. typhosus, paratyphosus* A and *paratyphosus* B bacilli. The dilutions in which complete agglutination occurred in half an hour at incubator temperature were taken as the standard.

The Uses and Limitations of the Widal Reaction.—As a large proportion of the patients examined had been inoculated against enteric fever, the diagnostic value of Widal's reaction was greatly modified.

If a series of Widal reactions are done on an inoculated person, on different days, the dilution in which complete agglutination occurs remains constant, and may be represented on a graph as a straight line.

In the case of a person suffering from enteric fever, and who has been inoculated, the dilution in which complete agglutination occurs varies on different days, usually rising but sometimes falling. In this case the dilutions graphically represented form a curve.

This fact was made use of as an indication in cases which were suspicious clinically to continue examining the stools, when the blood culture and the first two examinations of the stools had proved negative. In a few cases perseverance under these circumstances resulted in isolating the bacillus from the stools on the third or fourth examination.

The Widal reaction was even more useful in paratyphoid fever as an indication to persevere with bacteriological examinations. In many subacute cases of paratyphoid fever, the signs and symptoms are indefinite clinically, and any means one can adopt to show which cases can be negatived after one or two bacteriological examinations of the stools saves a vast amount of fruitless work.

The agglutination reaction is a means of telling whether a case is likely to prove positive or negative.

The examination of the agglutinative reactions of the blood of fifty inoculated cases which had not the clinical symptoms of enteric group disease, and from which no enteric group organism could be recovered, furnished the following results:—

(1) With *B. typhosus:* The blood in all cases gave a positive reaction. This reaction varied. The dilution in which complete agglutination occurred in half an hour varied between 1 in 30 and 1 in 200, the commonest dilution being 1 in 80.

(2) A group reaction often occurred with paratyphoid A and B in patients inoculated against enteric fever.

(3) With *B. paratyphosus* A: The blood was usually negative. Agglutination in up to 1 in 30 dilution did occur occasionally.

(4) With *B. paratyphosus* B: Agglutination occurred more readily than with *paratyphosus* A, but not constantly. Agglutina-

tion occurred up to 1 in 40 dilution, the commonest dilution being 1 in 20.

A typical agglutination result obtained in an inoculated case, not suffering from a disease of the enteric group, would be :—

B. typhosus	+ 1 in 80 in half an hour
B. paratyphosus A	− ,, ,,
B. paratyphosus B	− ,, ,,
or	
B. typhosus	+ 1 in 80 in half an hour
B. paratyphosus A	− ,, ,,
B. paratyphosus B	+ 1 in 20 in half an hour

Agglutination occurring in these dilutions was looked upon as the agglutinative capacity of the blood to *B. typhosus* and *B. paratyphosus* A and B, due to inoculation with enteric vaccine, and therefore was taken as a standard.

Agglutination in higher dilutions with *paratyphosus* A and B was looked upon as an indication of the presence of paratyphoid fever.

This assumption proved of great value in dealing with cases of suspicious clinical aspect, in which the *B. paratyphosus* was not recovered from the blood culture or from the first two examinations of the stools.

An agglutination in a dilution of 1 in 40 for paratyphoid A, or in 1 in 60 or 1 in 80 for paratyphoid B, was found to be practically diagnostic of paratyphoid fever, and by persevering with the examination of the stools the bacillus was isolated on the third or fourth examination.

In some cases, on repeating the Widal test, the dilution in which agglutination occurred was found to have increased in the case of one or other of the paratyphoids. This was extremely suggestive.

In view of these facts, cases which gave the standard inoculation agglutination result against the three organisms, and which exhibited an indefinite clinical aspect, were considered negative on two examinations of the stools.

This saved a vast amount of labour in plating subsequent stools, and laboratory space and medium, which are items of importance.

The statistics of the bacteriological results obtained may be grouped separately under the three diseases of the enteric group. These statistics are compiled from examinations made upon patients who were proved bacteriologically to belong to the enteric group.

Negative results in suspected cases which were proved not to belong to the group are excluded.

In some cases the day of the disease is sure to be inaccurate, owing to the difficulty in obtaining a definite history of the onset.

Enteric Fever.

Blood Cultures. — Results from 127 consecutive cases. The number of blood cultures which were positive or negative on the various days of the disease may be best seen on the following chart, which is taken from 122 cases :—

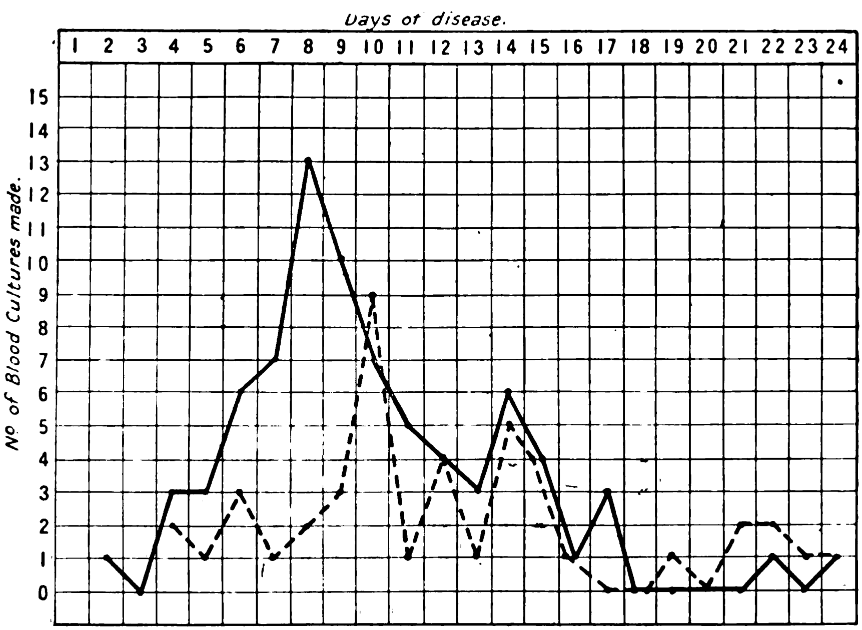

Chart 1.

In addition to these results—

1	negative	blood culture	was	taken	on the	twenty-eighth	day of disease.
2	,,	,,	,,	,,		twenty-ninth	,,
2	,,	,,	,,	,,		thirty-fifth	,,

The three blood cultures which were taken on the seventeenth day were all positive, and may have been due to an intercurrent relapse, the earliest positive culture obtained was on the second day of disease. The latest on the twenty-fourth day of disease.

The following chart represents the percentage of positive blood cultures obtained on the various days of disease :—

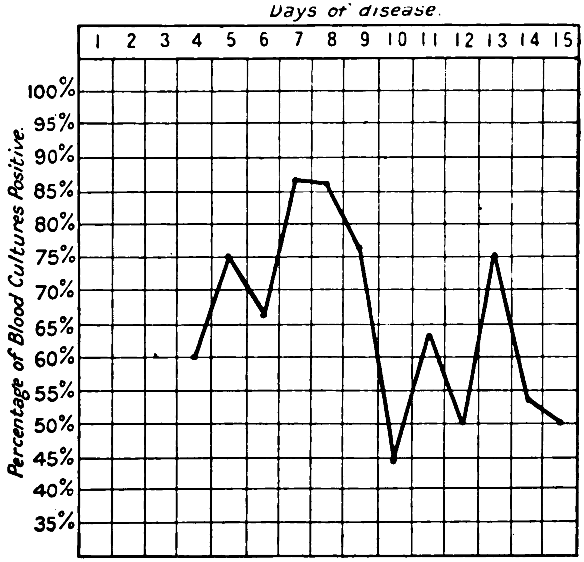

CHART 2.

On collecting these percentage results, it it found that—

(1) Blood cultures taken during the first nine days of the disease gave seventy-eight per cent positive (of fifty-five cultures taken).

(2) Blood cultures taken during the first fourteen days of the disease gave sixty-eight per cent positive (of one hundred cultures taken).

Examination of Fæces.—Chart showing positive and negative results obtained on the various days of disease, from the first examination of the fæces in eighty-four cases :—

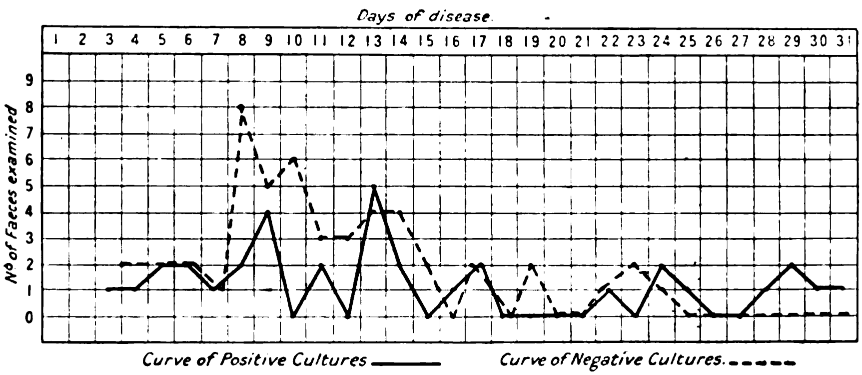

CHART 3.

The percentage of the first examinations of stools which were positive was 40.

In addition to these—

B. typhosus	was isolated	from the	stools of	9	cases	on the	second	examination.
B. typhosus	,,	,,	,,	3	,,		third	,,
B. typhosus	,,	,,	,,	2	,,		fourth	,,

The total results show that in 56·6 per cent of the cases examined, *B. typhosus* was isolated at the first or subsequent examination of the stools.

Paratyphoid A Fever.

The results are obtained from examinations made on 20 cases.

Blood Cultures.—Chart showing results from 19 cases. Blood culture was not done in one case :—

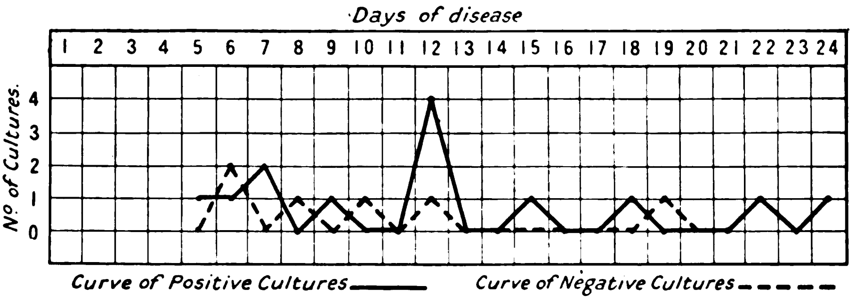

CHART 4

The percentage of positive blood cultures obtained was 67·6.

Examination of Fæces. — Fæces examined in nineteen cases. Chart of results of the first stool examined :—

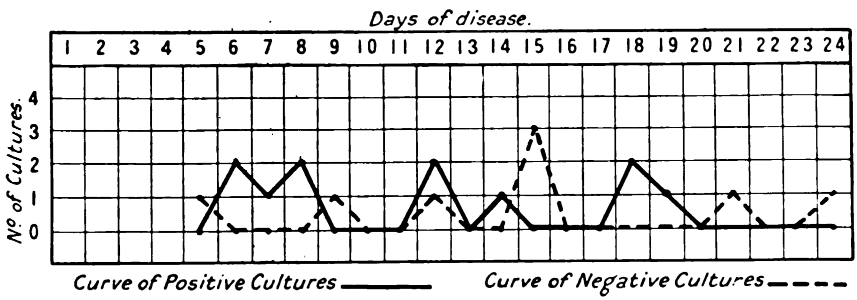

CHART 5.

Percentage of fæces positive on first examination, 57·2. Percentages of fæces positive on first or subsequent examinations, 63·1.

Paratyphoid B Fever.

Results taken from examination of seventy cases.

Blood Cultures. — Chart showing results of blood culture in sixty-four cases :—

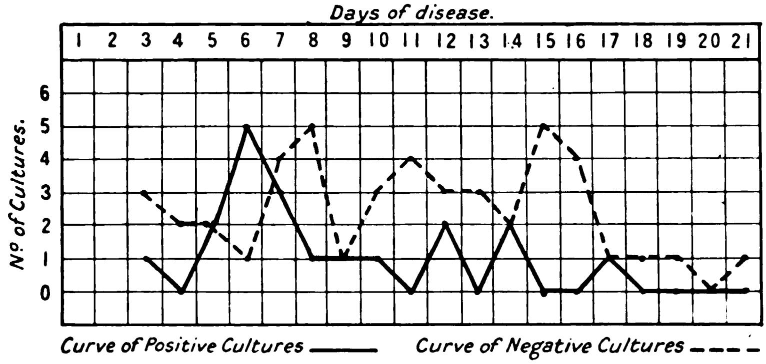

Chart 6.

Blood culture not done in six cases. Negative in one case, where blood was taken on the thirty-fourth day.

Percentage of blood cultures positive of all cultures made, 29·7. Percentage positive of blood taken for culture in the first seven days of disease, 47·8.

Examination of Fæces.—Chart showing results of first examinations of stools :—

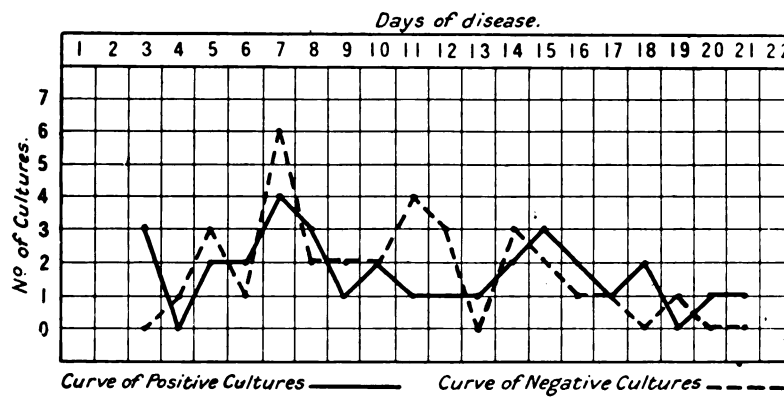

Chart 7.

1 case	negative	on the	twenty-fourth	day.
,,	,,	,,	twenty-sixth	,,
,,	,,	,,	thirtieth	,,
,,	,,	,,	thirty-sixth	,,

Percentage of positive examinations of first specimen taken, 46·3.

In 12 cases stools positive on second examination.
,, 5 ,, ,, ,, third ,,
,, 1 case ,, ,, fourth ,,

Total percentage of positive results obtained from first or subsequent examination of stools, 73·9.

Conclusions drawn from Statistical Results of the Cases Examined.

(1) *The blood culture* in enteric fever is of the first importance in diagnosis, for two reasons :—

(*a*) It is the most rapid method of diagnosis ; a matter of great importance in dealing with the prevention of the disease, and the segregation and examination of the contacts, especially under war conditions.

(*b*) A very large proportion of the cultures are positive ; seventy-eight per cent during the first nine days, sixty-eight per cent during the first fourteen days.

(2) The blood culture results in paratyphoid A are better than in paratyphoid B—67·6 per cent in the former as against 29·7 per cent in the latter.

This greater prevalence of a demonstrable septicæmia in the case of paratyphoid A is of interest, as *B. paratyphosus* A more nearly resembles *B. typhosus* in its bio-chemical reactions, whilst *B. paratyphosus* B resembles *B. coli,* which does not usually give rise to a demonstrable septicæmia.

(3) The results from the stool examinations in enteric fever do not show a high percentage of positive results as, in cases where a positive blood culture was obtained and the first stool proved negative, no subsequent examinations of the stools were made.

The converse may have something to do with the good results obtained from the stools in paratyphoid B fever, as in that disease the percentage of positive blood cultures was low and the examination of the stools was persevered with.

Relapses.

Enteric Fever.

In the enteric cases blood cultures were performed on two or three cases during a relapse with negative results.

Paratyphoid Fever.

Two cases were examined during a relapse.

(1) A case which gave a positive blood culture of *B. paratyphosus* A on the ninth day of disease had a definite relapse

during which *B. paratyphosus* A was again isolated from the blood on the thirtieth day of the disease.

(2) A case was admitted on the thirteenth day of disease. The temperature was between 99° F. and 100° F. and the patient's condition good. *B. paratyphosus* B was isolated from the stools on the fifteenth day of disease. The blood culture was negative. The patient's temperature fell and remained steady for a fortnight. On the thirtieth day of disease the patient had a definite relapse with high temperature. Blood was taken for culture and *B. paratyphosus* A isolated from the blood.

This latter case, in which the organism isolated during the relapse was different from that originally isolated, is of interest in view of the suggestion that relapses are due to a mixed infection with various members of the group.

A relapse, according to this view, is due to the infection by the secondary organism becoming predominant when immunity had been established against the original infecting organism.

Epidemiology.

A survey of the numbers of the cases *diagnosed* during the six months under observation shows the following results :—

(1) The greatest number of enteric cases diagnosed was during January.

(2) A great fall in the number of enteric cases occurred during April.

(3) The number of paratyphoid cases diagnosed rose steadily from January until April, and then fell quickly during May.

(4) There was a slight rise of both enteric and paratyphoid cases during June, which might possibly be accounted for by the warmer weather and the advent of flies.

Chart 8 shows the number of cases *diagnosed* during each of the six months during which cases were examined.

With regard to this chart, two criticisms may be made of the curve of the paratyphoid cases :—

(1) The figures for January and the early part of February are so low probably because at that time paratyphoid fever was not recognized as being such a prevalent disease, and many cases which had indefinite symptoms were missed, and so escaped the bacteriologist's hands.

(2) The curve for paratyphoid fever rises rapidly from March to April, whereas that for typhoid falls during the same period. These curves do not show the true epidemiological incidence of

the diseases, as they represent the times when the cases were diagnosed and not the date of onset.

Now as the bulk of the typhoid cases were diagnosed early by blood culture and the bulk of the paratyphoid B cases rather late in the disease by stool examination, it would follow that the curve for paratyphoid fever should be put back for about a fortnight in order to arrive at the relative number of cases of the two diseases whose onset was during the same period of time.

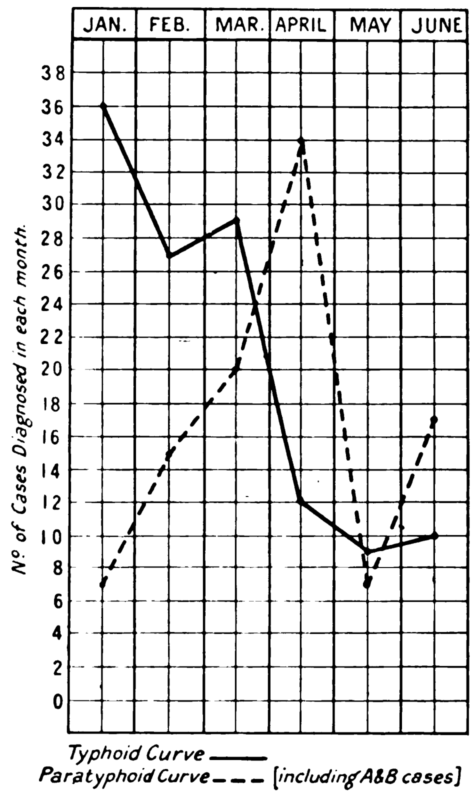

CHART 8.

This would make the fall in the incidence of paratyphoid fever almost coincident with that of typhoid fever.

EFFECT OF INOCULATION ON THE INCIDENCE OF ENTERIC FEVER.

The following chart demonstrates the number of cases of typhoid fever diagnosed each month, non-inoculated, partially protected and fully protected cases being represented on separate

curves. Partial protection equals one dose or two doses with a long interval. Full protection equals two doses within two years.

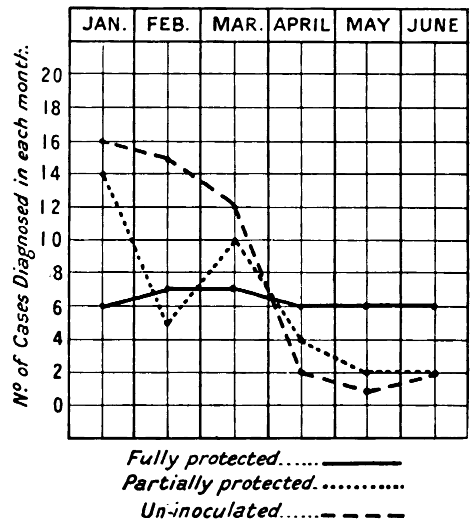

CHART 9.

Several interesting and suggestive inferences may be drawn from this chart :—

(1) The greatest number of uninoculated cases was diagnosed during the earlier part of the investigation. This number fell steadily until May.

This fall coincided with the increase in the percentage of fully protected men among the troops.

(2) The partially protected cases decreased irregularly. The decrease coincided with the increase in the percentage of fully protected men among the troops.

(3) The number of cases in fully protected patients diagnosed during each month was remarkably constant. Six were diagnosed in each of four of the months under observation and seven in each of the two other months.

This constant number of cases diagnosed in fully protected persons may occur as a result of there being certain subjects whose natural resistance to enteric is so small that prophylactic inoculation is unable to raise their resistence sufficiently to render them immune to the typhoid bacillus.

Another fact is suggestive of the value of inoculation. During

the months under observation, the number of cases of enteric fever occurring in fully protected persons was constant and the percentage of fully protected men among the troops rose considerably; but the total number of troops in France among which the cases occurred also increased enormously. The percentage of cases occurring among fully inoculated persons therefore fell enormously during these months.

EFFECT OF INOCULATION UPON THE BLOOD CULTURE.

It seems fair to assume that where the technique is identical a positive blood culture may be some indication of the intensity of the septicæmia present. In enteric fever it was found that the greatest number of positive blood cultures occurred in non-inoculated persons. The percentage of positive blood cultures was slightly higher in the case of fully protected than in partially protected subjects.

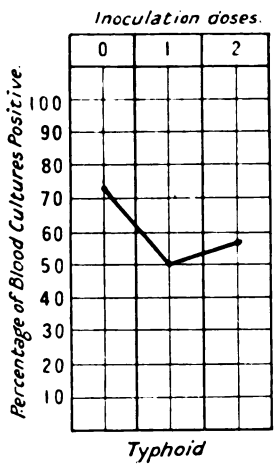

CHART 10.

This may be accounted for in one of the following ways:—

(1) The fully protected patient only contracts the disease when exposed to a very virulent infection.

(2) The fully protected patient who contracts enteric fever, and who has a demonstrable septicæmia, possesses such a feeble resistance that inoculation is unable to protect him against an average infection with *B. typhosus*.

The relative percentages of positive blood cultures are represented upon the above chart.

In this connection it is interesting to study the parallel results obtained in the cases of paratyphoid A and paratyphoid B examined.

Inoculation with typhoid vaccine causes a certain degree of immunity against the paratyphoid bacilli. In the two curves of the percentage of positive blood cultures in inoculated and non-inoculated cases, it is interesting to note the similarity between the curve for paratyphoid A and that for typhoid.

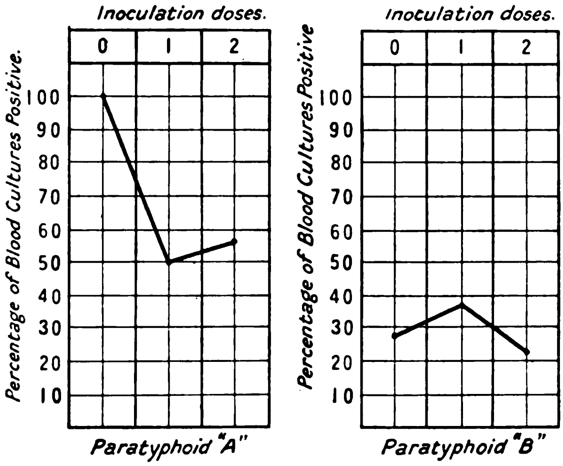

CHART 11.

The curve for paratyphoid B was dissimilar. This similarity of paratyphoid A is not very surprising, as *B. paratyphosus* A shows a greater resemblance than *B. paratyphosus* B.

In conclusion, it may be urged that the only way in which rapid and accurate diagnosis of cases of the enteric group may be arrived at is for the bacteriologist to keep in touch with the clinical side of the subject and to visit the wards regularly. A study of the temperature charts is of great assistance in making up one's mind as to what examination is most likely to give a positive result.

A constant co-operation and exchange of ideas between the physician and the bacteriologist are of the highest importance for the successful diagnosis of cases belonging to the enteric group.

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A CLASSIFICATION OF MENINGOCOCCI BASED ON GROUP AGGLUTINATION OBTAINED WITH MONOVALENT IMMUNE RABBIT SERA.

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That all strains of meningococci are not affected equally by an immune serum prepared against any one strain has long been known. This has led to the conception that there are within the meningococcus group types of organisms which are more or less immunologically independent. This conception, borne out by the practical results in the treatment of human cases, has led to the universal adoption of a polyvalent serum in the treatment of cerebrospinal fever. Though this conception of variant types of meningococcus has long existed, the number of types which occur and the degree of specificity which exists within these types has never been determined. It is for this reason that, in the preparation of the therapeutic sera, as many strains as possible have been used and the strains obtained from widely varying geographical sources. In this way it was hoped to include representatives of all existing types.

The purpose of this communication is to show that, by means of a specific immune reaction, two types of organism causing cerebrospinal fever can be demonstrated, and that of forty-six organisms studied, all belonged to one or other of these types. It will be shown, moreover, that both types are widely distributed, representatives of each type having been found in six different epidemic foci, that they occur in some epidemics with nearly equal frequency, and that the differentiation obtained is such as to suggest the probable complete immunological independence of the two types.

The earliest attempts made to differentiate types of meningococci were mainly directed towards establishing points of difference between the organism isolated in cases of epidemic meningitis and those from the sporadic cases of this disease, the so-called posterior basic meningitis. These attempts were unsuccessful.

In 1909, Elser and Huntoon [1] described an organism indistinguishable from the meningococcus except by means of agglutinin absorption tests. To this organism they gave the name pseudo-

meningococcus. In their article the source from which these organisms were obtained is not very clearly stated, but apparently they were all isolated from the nasopharynx. They speak of the pseudo-meningococcus as "only rarely encountered in the throats of normal and diseased subjects," and do not consider that it interferes with the practical identification of the meningococcus or of meningococcus carriers. They do not seem to look upon the pseudo-meningococcus as a causative agent of cerebrospinal fever.

In the same year Dopter [2] studied and described a similar organism also obtained from the upper air-passages, to which he gave the name parameningococcus. This organism, probably identical with the pseudo-meningococcus of Elser and Huntoon, has since been found by Dopter and other French workers to invade the blood and meninges, and is looked upon by them as one of the causative agents in epidemic meningitis. An antiserum against this organism has been prepared by Dopter, and successfully used in the treatment of human patients.

Recently Wollstein [3] has made a careful comparative study of the immune reactions of the meningococcus and the parameningococcus of Dopter. From her investigations she came to the conclusion that "the parameningococci of Dopter are culturally indistinguishable from true or normal meningococci, but serologically they exhibit differences as regards agglutination, opsonization, and complement fixation." Because of the variations and irregularities of serum reactions existing amongst otherwise normal strains of meningococcus, it does not seem either possible or desirable to separate the parameningococci into a strictly definite class. It appears desirable to consider them as constituting a special class among meningococci, not, however, wholly consistent in itself. It will be seen, therefore, that though there is apparently some variation in the reaction to immune sera of certain organisms isolated from cases of cerebrospinal fever, no sharp-cut differentiation of meningococci has as yet been made, and no record of the frequency with which these aberrant or parameningococcic strains occur is available.

In reviewing the literature of meningococcus agglutination, two facts immediately impress themselves; first, the wide variation in agglutinability of different strains of meningococci; and second, the susceptibility of certain strains to agglutination by any serum, normal or immune, that is susceptibility to non-specific agglutination. Thus Arkwright [4], and also Elser and Huntoon [5],

have shown that gonococcus immune serum will agglutinate certain strains of meningococcus in as high dilutions as will meningococcus immune serum. Elser and Huntoon, however, noticed that in such cases, while the final result with gonococcus and meningococcus serum was the same, the rate at which the reaction occurred in the two instances varied widely, the reaction being much more rapid with meningococcus serum.

In all previous work done with the agglutination of the meningococcus, the agglutinations have been done with increasing dilutions of serum, and the highest dilution in which agglutination has occurred at the end of twenty-four hours has been taken as the standard of agglutination. In the light of the above results it seemed possible that when a period of twenty-four hours was allowed to elapse before readings were made, a more slowly occurring non-specific agglutination might frequently mask all specific results. It seemed advisable, therefore, to see if by allowing a powerful serum to act over a short period of time, specific differences could be demonstrated which were missed when the ordinary method of diluted serum, acting for twenty-four hours, was used. Undiluted serum was therefore employed, and the agglutinations which immediately ensued noted. It was at once determined that with this method marked differences between strains of meningococci could be demonstrated.

Method.

Monavalent sera were prepared by immunizing rabbits against single strains of meningococcus. The rabbits were immunized by intravenous injections given at weekly intervals, the dose consisting usually of half a slant culture of twenty-four to seventy-two hours' growth. The first two or three injections were made with organisms killed by heating at 60° C. for thirty minutes ; subsequent injections were of living organisms. Five injections usually produced a satisfactory agglutinating serum.

Agglutinations were all done macroscopically, equal quantities of undiluted serum and of rather thin bacterial emulsions being drawn into a capillary pipette, thoroughly mixed on a glass slide and the mixture again drawn into the pipette, the tip of which was then sealed in the flame. In the case of prompt reaction, agglutination takes place before the mixing is completed, all the organisms becoming almost instantaneously tightly clumped, leaving a clear supernatant fluid. These tubes were read immediately and then left at room temperature, readings being again made at the

end of an hour and on the following morning. In recording the results of agglutinations the following designations were employed: + + complete clumping of the organisms leaving a clear or faintly opalescent fluid, + majority of organisms clumped the supernatant fluid remaining opalescent, ± slight clumping, and – no clumping though in the course of twenty-four hours slight sedimentation may occur.

Experimental.

Rabbits were immunized against eight different strains of meningococci. Unfortunately four of these eight strains were lost before their agglutination reactions could be tested, so that cross agglutinations between the whole eight strains and their corresponding sera could not be carried out. They were, however, done with the four remaining strains. The results are shown in Table I. It is to be understood that these results were not all obtained on one day, but represent the combined protocols of three separate experiments.

TABLE I.—Agglutination of Meningococcus Strains by Homologous and Heterologous Monovalent Immune Rabbit Sera.

Sera	Meningococcus strains											
	M. 4			M. 7			M. 9			M. 13		
	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours
Rabbit 53, M. 3	–	+	++	±	++	++	–	–	±	+	+	+
,, 76, ,, 4	++	++	++	++	++	++	–	–	–	++	++	++
,, 83, ,, 5	–	+	++	±	±	+	–	–	–	±	±	+
,, 56, ,, 6	–	–	+	–	–	±	++	++	++	–	–	–
,, 58, ,, 7	–	+	++	+	++	++	–	–	+	+	+	+
,, 15, ,, 9	–	–	++	–	–	+	++	++	++	–	–	+
,, 84, ,, 11	–	–	++	–	–	+	++	++	++	–	–	+
,, 69, ,, 13	+	++	++	++	++	++	–	–	+	++	++	++

It will be seen that the three strains M. 4, M. 7, and M. 13, were agglutinated by five of the eight sera employed (see M. 3, M. 4, M. 5, M. 7, M. 13), though in the case of three of these (sera M. 3, M. 5, M. 7) the agglutination was feeble. Three sera (M. 6, M. 9, M. 11) failed entirely to agglutinate these organisms. The reactions with strain M. 9 were, on the other hand, exactly opposite, the five sera (M. 3, M. 4, M. 5, M. 7, M. 13) failing to agglutinate this strain, while prompt agglutination occurred with the three (M. 6, M. 9, M. 11) which failed to agglutinate the other three organisms.

That the feeble agglutination in the case of sera M. 3, M. 5, and M. 7 was due to a simple lack of potency of these sera, and not to difference in the organisms, seems probable, since, in the only case where it could be tested (M. 7) agglutination was equally feeble with the homologous organism.

On the basis of these results it would seem that two types of meningococci can be differentiated according to their reaction to monovalent immune rabbit sera. These we shall designate types 1 and 2. To type 1 belong M. 4, M. 7, M. 13, and since sera prepared by immunizing rabbits to strains M. 3 and M. 5 agglutinate these organisms it is evident that they also are of this type. Similarly M. 6, M. 9, and M. 11 are evidently another type, which we shall designate type 2. A second point which is brought out in Table I is perhaps worthy of mention. This is the well-known variation in the agglutinability of different strains of meningococci. It will be seen that M. 7 and M. 13 show almost identical reactions, while with M. 4, though qualitatively the same, they are quantitatively weaker, the three weak sera failing to give any immediate reaction, and showing, only at the end of an hour, agglutinations comparable to the immediate reactions obtained with the more agglutinable strains.

A preliminary classification into two types having been thus obtained, it was necessary to determine whether such results would hold when applied to a large number of strains of meningococci. All available strains were, therefore, tested with strongly agglutinating sera of both types. The results are shown in Table II. The type 2 serum which was at first employed was not as powerful as one which was afterwards produced, so that the reactions of this group were not at first quite as sharp as those later obtained. In Table II strain M. 33 marks the beginning in the use of more powerful type 2 serum.

Table II shows clearly the sharp differentiation of two types of meningococci, all the strains tested with three exceptions (M. 18, M. 39, M. 49) belonging clearly to one or other type. These three inagglutinable strains will be considered later. Excepting them, we see that in no case did immediate agglutination fail to occur with the proper type serum. Cross agglutination between types was never seen immediately, but did occur three times at the end of an hour (M. 28, M. 32, M. 56). In two of these three instances however, the strains showed agglutination of equal extent with normal serum (M. 32, M. 56). Only one example of true cross agglutination therefore occurred (M. 28), and here the reaction

was so slight that it could not possibly interfere in the differentiations of the type to which this strain belonged. As will be seen by Table II, three strains could not be classified, M. 18, M. 39, M. 49,

TABLE II.—AGGLUTINATION OF MENINGOCOCCUS STRAINS BY MONOVALENT SERA, TYPES 1 AND 2.

Strains	Sera						Normal rabbit		
	Type 1			Type 2					
	Rabbit 69, M. 13		Rabbit 76, M. 4	Rabbit 84, M. 11		Rabbit 56, M. 6			
	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours
M. 10 ..	++	++	++	–	–	–	–	–	–
,, 12 ..	–	–	+	++	++	++	–	–	+
,, 18 ..	–	–	+	–	–	+	–	–	+
,, 19 ..	++	++	++	–	–	–	–	–	–
,, 20 ..	++	++	++	–	–	+	–	–	+
,, 21 ..	++	++	++	–	–	+	–	–	+
,, 22 ..	++	++	++	–	–	–	–	–	–
,, 23 ..	++	++	++	–	–	–	–	–	–
,, 24 ..	++	++	++	–	–	±	–	–	±
,, 25 ..	++	++	++	–	–	–	–	–	±
,, 26 ..	–	–	+	±	+	++	–	–	++
,, 27 ..	++	++	++	–	–	+	–	–	–
,, 28 ..	–	±	++	+	++	++	–	–	++
,, 29 ..	++	++	++	–	–	+	–	–	++
,, 30 ..	–	–	+	+	++	++	–	–	±
,, 31 ..	++	++	++	–	–	±	–	–	±
,, 32 ..	++	++	++	–	+	++	–	++	++
,, 33 ..	–	–	±	++	++	++	–	–	+
,, 34 ..	++	++	++	–	–	+	–	–	++
,, 35 ..	–	–	–	++	++	++	–	–	+
,, 36 ..	++	++	++	–	–	+	–	–	++
,, 37 ..	–	–	+	++	++	++	–	–	–
,, 38 ..	++	++	++	–	–	+	–	+	++
,, 39 ..	–	–	±	–	–	+	–	–	–
,, 40 ..	–	–	++	++	++	++	–	–	++
,, 41 ..	++	++	++	–	–	–	–	–	++
,, 42 ..	–	–	±	++	++	++	–	–	±
,, 43 ..	++	++	++	–	–	±	–	–	++
,, 45 ..	++	++	++	–	–	–	–	–	±
,, 46 ..	++	++	++	–	–	±	–	–	–
,, 47 ..	++	++	++	–	–	±	–	–	++
,, 48 ..	++	++	++	–	–	±	–	–	+
,, 49 ..	–	–	–	–	–	+	–	–	–
,, 50 ..	++	++	++	–	–	–	–	–	±
,, 51 ..	++	++	++	–	–	+	–	–	++
,, 53 ..	–	–	+	++	++	++	–	–	+
,, 55 ..	–	–	+	++	++	++	–	–	±
,, 56 ..	++	++	++	–	±	++	–	±	++

failing to agglutinate with sera of either type. Further investigations showed that the inagglutinability of these three strains was only a relative affair, and that when more potent type 2 serum,

TABLE III.

AGGLUTINATION REACTIONS OF RELATIVELY INAGGLUTINABLE MENINGOCOCCUS STRAINS AND THEIR MONOVALENT ANTISERA.

Sera	Meningococcus strains														
	Type 1, M. 20			Type 2, M. 37			M. 18			M. 39			M. 49		
	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours
Type 1, Rabbit 76, M. 4	++	++	++	−	−	+	−	−	±	−	−	±	−	−	−
Type 2, Rabbit 66, M. 12	−	−	−	++	++	++	±	±	+	++	++	++	++	++	++
Rabbit 4, M. 18 ..	−	−	−	++	++	++	−	−	±	−	±	+	±	+	++
Rabbit 21, M. 39 ..	−	−	−	++	++	++	−	−	±	−	−	±	−	±	++
Rabbit 90, M. 49 ..	−	−	−	++	++	++	−	−	±	−	+	+	±	+	++
Normal Rabbit ..	−	−	−	−	−	±	−	−	±	−	−	±	−	−	±

e.g., rabbit 66 M. 12, obtained by more prolonged immunization of rabbits, was used, some degree of agglutination of even these resistant strains occurred (Table III). It was noticed, moreover, that the agglutinability of these strains varied from day to day, an organism which had failed to agglutinate one day showing typical prompt agglutination the next. In order to prove definitely the relationship of these exceptional strains monovalent sera were prepared against all three and cross agglutinations were then carried out between these sera, their homologous organisms and known representatives of types 1 and 2. The results are shown in Table III.

It will be seen that all three strains are certainly representatives of type 2, since their antisera give typical agglutination of a known type 2 organism (M. 37), and fail to show any reaction with an organism of type 1 (M. 20). It will be noticed that the three show a graded variation in their degree of inagglutinability—M. 18 the most inagglutinable, M. 39 next, and finally M. 49, which, with a powerful type 2 serum, shows immediate agglutination. It is clearly shown that the failure of these organisms to react is due to their inherent inagglutinability, and not to any difference in type, since in every case their antisera agglutinate an agglutinable type 2 organism more strongly than they do their homologous organism. Moreover, within the group the reactions take place according to the evident potency of the sera and agglutinability of the organisms, and not according to whether homologous or heterologous serum is employed. Thus rabbit 21 (M. 39) fails entirely to agglutinate its homologous organism, while it agglutinates strongly the agglutinable type 2 organism (M. 37), and weakly the relatively inagglutinable strain M. 49. The same phenomenon is seen with the serum of rabbit 4 (M. 18).

In Table II the results of exposing a number of strains of meningococcus to type 1 and type 2 serum were shown. By way of confirming these results, the effects of exposing organisms of types 1 and 2 to the action of sera prepared against a number of the strains tabulated in Table II have been studied. These results are shown in Table IV.

It will be seen that these results are in every case confirmatory. The antisera prepared against the two organisms of type 1 alone agglutinating the type 1 strain, while the type 2 organism is agglutinated only by antisera of organisms previously determined as of type 2.

It has thus been shown that without exception all strains of

meningococci, so far met with in this investigation, can be placed in one or other of two types. There remains to be considered the distribution of these types and their relations to the para-meningococcus of Dopter.

TABLE IV.—AGGLUTINATION OF MENINGOCOCCUS STRAINS, TYPE 1 (M. 4) AND TYPE 2 (M. 12), BY MONOVALENT RABBIT SERA PRODUCED BY IMMUNIZING WITH VARIOUS MENINGOCOCUS STRAINS M. 4 AND M. 48 TYPE 1, THE REMAINDER TYPE 2. NORMAL RABBIT SERUM CONTROL.

Sera	Meningococcus strains					
	Type 1, M. 4			Type 2, M. 12		
	Immediate	1 hour	24 hours	Immediate	1 hour	24 hours
Rabbit 76, M. 4..	++	++	++	–	–	±
,, 56, ,, 6..	–	–	±	++	++	++
,, 15, ,, 9..	–	–	±	++	++	++
,, 66, ,, 12..	–	–	++	++	++	++
,, 27, ,, 18..	–	–	+	+	++	++
,, 22, ,, 39..	+	±	++	++	++	++
,, 87, ,, 42..	–	–	++	++	++	++
,, 11, ,, 48..	++	++	++	–	–	±
,, 90, ,, 49..	–	–	++	++	++	++
Normal rabbit ..	–	–	±	–	–	±

TABLE V.—CLASSIFICATION OF MENINGOCOCCI ISOLATED FROM THE SPINAL FLUID OF PATIENTS FROM VARIOUS EPIDEMIC FOCI.

Classification obtained by Agglutination with Monovalent Rabbit Sera.

	British Expeditionary Force, France		1st Canadian Contingent Salisbury Plain		Tidworth		Reading		Woolwich		London	
	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2	Type 1	Type 2
	M. 3	M. 6	M. 7	M. 9	M. 27	M. 26	M. 29	M. 30	M. 31	M. 33	M. 41	M. 42
	,, 4	,, 18	,, 10	,, 11	..	,, 28	..	..	,, 32	,, 35	,, 43	,, 49
	,, 5	,, 39	,, 13	,, 12	..	..	..	..	,, 43	,, 37	,, 45	..
	,, 20	,, 40	,, 19	..	..	..	..	..	,, 36	..	,, 46	..
	,, 21	,, 53	,, 22	..	..	..	..	..	,, 38	..	,, 47	..
	,, 50	,, 55	,, 23	..	..	..	..	..	..	..	,, 48	..
	,, 51	..	,, 24	..	..	..	..	..	..	..	..	..
	,, 56	..	,, 25	..	..	..	..	..	..	..	..	..
Totals	8	6	8	3	1	2	1	1	5	3	6	2

	Total number.	Per cent.
Type 1,	29 =	63 per cent.
,, 2,	17 =	37 ,,
Total ..	46	100 per cent.

The strains of meningococcus which have been studied were isolated from patients in six different epidemic foci. For those from the Tidworth, Reading, Woolwich, and London epidemics

I am indebted to Dr. J. A. Arkwright, of the Lister Institute, and for some of the strains isolated in France to Captain J. W. McNee, No. 3 Mobile Laboratary. In Table V is shown the epidemic focus from which individual strains were obtained, and the number of each type found in the strains from these various sources.

Organisms of both types were found in all six epidemic foci. Type 1 was more common than type 2, but in the case of the British Army in France the difference was negligible. It is, perhaps, of some significance that this group in which the proportion is more nearly equal embraces the largest number of organisms, the widest distribution in area, and the most nearly constant conditions of isolation and subsequent growth of the organisms. It will readily be seen that in a heterogeneous collection, such as these forty-six strains represent, a slight variation in case of isolation or of subsequent viability of one type, as compared with the other might completely upset all calculations. In contradistinction to the greater frequency of type 1 in these strains isolated from the spinal fluid, we have found in five strains of meningococci, isolated from the nasopharynx of healthy carriers, type 2 four times and type 1 once. The exact frequence with which the two types of meningococci occur can then only be determined by a study of the infecting organism in every case of a large series. It will probably be found to vary in different places and in different years. It seems obvious, however, that both types are widely distributed, and must be held equally responsible as causative agents of cerebrospinal fever.

TABLE VI.—Agglutination Reactions of Parameningococcus.

Monovalent Rabbit Sera of Types 1 (*Rabbit* 76, *M.* 4) *and* 2 (*Rabbit* 66, *M.* 12) *v.s. Parameningococcus* (*Parameningocoque St. Quay*). *Monovalent Rabbit Antiparameningococcus Serum* (*Rabbit* 42, *Parameningocoque, St. Quay*) *v.s. Organisms, Type* 1 (*M.* 20) *and Type* 2 (*M.* 37). *Normal Rabbit Serum Control.*

Sera	Meningococcus and Parameningococcus strains								
	Type 1, M. 20			Type 2, M. 37			Parameningocoque St. Quay		
	Immediate	1 hr.	24 hrs.	Immediate	1 hr.	24 hrs.	Immediate	1 hr.	24 hrs.
Type 1, Rabbit 76 (M. 4)	++	++	++	–	–	±	–	–	–
Type 2, Rabbit 66 (M. 12)	–	–	+	++	++	++	++	++	++
Antipara. rabbit 42 (Parameningocoque, St. Quay)	–	–	–	++	++	++	++	++	++
Normal rabbit	–	–	±	–	–	±	–	–	–

The relation of the parameningococcus of Dopter to the types above described has been determined for one strain of parameningococcus. This strain, known as "parameningocoque St. Quay," was obtained through the kindness of Dr. Arnaud Netter, of Paris, and was isolated by Dr. Matthias Pierre Weil. Its reactions are shown in Tables VI and VII; they are identical with an organism of type 2.

TABLE VII.—AGGLUTINATION REACTIONS OF PARAMENINGOCOCCUS.

Monovalent Rabbit Sera, Types 1 and 2, v.s. Parameningococcus Strain, Parameningocoque, St. Quay. Normal Rabbit Serum Control.

Serum	Parameningocoque, St. Quay. Immediate	1 hour	24 hours
Type 1, Rabbit 76, M. 4	–	–	–
„ 1, „ 11, „ 48	–	–	+
„ 2, „ 66, „ 12	++	++	++
„ 2, „ 90, „ 49	++	++	++
„ 2, „ 15, „ 9	++	++	++
„ 2, „ 27, „ 18	+	++	++
„ 2, „ 87, „ 42	++	++	++
Normal rabbit	—	–	–

Another strain of parameningococcus, obtained from the Pasteur Institute, has also been studied. Unfortunately this organism possessed such a high degree of non-specific agglutinability and such low antigenic properties that its exact relations could not be determined. It too, however, appeared to be a member of type 2.

It would seem probable therefore that our type 2 meningococcus and the parameningococcus of Dopter are identical. In view of the apparent frequence with which this organism causes cerebrospinal fever, the identical character of the disease caused by the two types, and, if we except immune reactions, the exact similarity of the two organisms, it would seem desirable to call both types of organism the meningococcus, and to drop the use of such terms as para- and pseudo-meningococcus, which are only complicating and misleading. In this connection it may be interesting to point out that the occurrence of types of meningococci differing only in their immune reactions has an exact parallel in the types of pneumococci demonstrated by Dochez and Gillespie [6], where four types of pneumococci causing lobar pneumonia have been established.

The occurrence of two types of meningococci and the fact that all organisms so far tested will react to a monovalent immune serum of one or other type, suggests at once the possibility of the treatment of human cases of cerebrospinal fever with such monovalent sera. It is probable that in this way more powerful antisera could be prepared than by the haphazard choice of strains for the immunization of horses such as at present obtains. In the

preparation of monovalent type sera, the most powerful antigenic strain of each type would of course be used. For the first treatment of the patient a mixture of the two sera could be used, to be followed, as soon as the type of the infecting organism is determined, by the appropriate monovalent serum. Such a scheme would seem to put the serum treatment of cerebrospinal fever on a much sounder basis, and would prevent the occurrence of situations such as were common in England last winter, where patients were treated with sera which, even *in vitro*, showed no effect on the organism causing the disease. Here we may again point to the parallelism with pneumonia, where the use of a similar method [7] has led to a much clearer understanding of the difficulties and possibilities of serum therapy.

SUMMARY.

(1) The causative agent of cerebrospinal fever, the meningococcus, is of at least two types.

(2) These two types are, as regards the one immune reaction tested, agglutination, absolutely independent.

(3) In a study of forty-six strains of meningococci, obtained from various sources, all were of one or other of these two types.

(4) Both types are widely distributed, having been found in each of six epidemic foci. They may occur with equal frequency.

(5) Both types have been found in the nasopharynx of healthy carriers.

(6) We have designated these two types, types 1 and 2.

(7) In so far as evidence is available, type 1 has been more frequently the cause of the disease in the recent epidemics than has type 2. In view of the wide distribution of the two types both must, however, be held equally responsible as causative agents of cerebrospinal fever.

(8) The organism herein described as type 2 is probably identical with the parameningococcus of Dopter.

(9) It is suggested that, in the treatment of cerebrospinal fever, better results might be obtained and more exact knowledge of the adequacy of serum treatment gained, if, monovalent horse serum of appropriate type, and therefore known to be active against the infecting organism, were employed in place of the polyvalent sera at present in use.

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MENINGOCOCCUS CARRIERS.

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The maintenance of wards in the Inoculation Department by the Medical Research Committee has enabled us to carry out some investigations upon a group of meningococcus carriers—in particular upon methods directed to remedy their carrying.

Although the work has led to few positive conclusions, publication at the present time has seemed worth while, since the opportunity for further observations has passed with the seasonal decline of the epidemic of meningitis, and it is hoped that some of the findings and suggestions may serve as starting points for future research.

The methods employed for the cultivation and recognition of the meningococcus of carriers, call for no detailed description, since we have conformed for the most part to the usual procedure, i.e., making plate cultures from post-nasal swabs (West).

The medium used throughout has been a nutrient agar enriched with a small amount (about two per cent) of either ascitic or hydrocele fluid. The nutrient agar was prepared in the manner suggested by Captain S. R. Douglas from a broth obtained by the digestion of heart muscle with trypsin. On this medium the meningococci have given much more vigorous growth than upon ordinary agar made from beef extract broth to which commercial peptone had been added, similarly enriched with a serous fluid, or upon such samples of "nasgar" as we have tried. It is of importance that the surface of the agar should be moist when cultivations are made from post-nasal swabs for the detection of meningococcus carriers.

Colonies regarded as the meningococcus grew in very large numbers on the plates made from eleven of the twelve carriers here reported upon, ten of whom had been in contact with at least one case of cerebrospinal meningitis, while the remaining two had been in daily contact with these ten carriers without wearing any protective mask.

The cultures were of a uniform type and conformed to the classical descriptions of the meningococcus in respect of:—

(1) The appearance of the original colonies—transparent edges, slightly more opaque centre, opalescent sheen, &c.

(2) Microscopical appearances of the cocci, including degenerative forms (shadows), within twenty-four hours of planting and staining reactions.

(3) Fermentation of glucose but not of saccharose.

(4) Tendency to die rapidly on artificial media and inability to grow at 23° C. within two days. (Cultures were not as a rule incubated longer.)

The Infectivity of Meningococcus Carriers.

When the history of the recent epidemic of meningitis comes to be written, one may hope to find a clear record of every case in which the disease has developed in a known carrier or can be definitely traced to contact with a carrier.

Probably the total number of such cases will be small. However that may be, it seems safe to surmise that they will be shown to be exceptional rather than the rule, and that the great majority of carriers will be found to have themselves escaped the meningeal infection and to have been innocent of causing it in others.

The explanation of this is not yet clear, but it is very important that it should be found, since it may be expected to show what policy ought to be adopted with regard to carriers.

Being little disposed to follow those recent writers who, in face of this difficulty, would throw over altogether the meningococcal origin of cerebrospinal meningitis, we have kept in view the three hypotheses which seemed most likely to yield the true explanation. These are: (1) That the majority of carriers and of normal individuals possess an adequate "natural immunity" towards the meningococcus; (2) that the microbe present in the naso-pharynx of carriers, notwithstanding its close resemblance, is not identical with the meningococcus obtained from the cerebrospinal fluid in meningitis, and, unlike the latter, shows no predilection for attacking the meninges; (3) that the microbe of carriers, although a true meningococcus, is habitually of too low a virulence to determine a meningitis.

Such data as are available for judgment between these three hypotheses may be briefly set down as follows:—

Firstly, it is well known that persons attacked by meningitis, and particularly those who make a good recovery therefrom, give evidence of quite definite changes in the blood—changes which may be

regarded as the expression of an immunizing effort ("acquired immunity").

Thus the development of agglutinin and of a greatly enhanced opsonic power are both shown in very striking fashion in a simple opsonic preparation from such a patient's blood, as was pointed out by Houston and Rankin.[1]

If the majority of carriers were protected by a "natural immunity" from this disease, one might expect to find evidence of the protective mechanism by a similar examination of their blood.

Opsonic preparations with the sera of several carriers have shown, however, no trace of agglutination, nor any increase of phagocytosis over and above that obtained with normal sera.

This latter observation is made with some reserve, since the opsonic tests in question numbered only about ten; and, moreover, were performed at a time when it was possible to detect only gross changes of opsonic power to the meningococcus, owing to the little phagocytosis obtained and the rapid intracellular digestion of the few cocci which were ingested.

Subsequent work has shown that, by slight changes in the opsonic technique first adopted, much more satisfactory phagocytic counts can be obtained.

These changes are: (*a*) The use of a very fresh culture of meningococcus, i.e., within an hour or two of growth becoming apparent. (*b*) Reversion to the original method of opsonic mixtures employed by Wright and Douglas (*Proc. Roy. Soc.*, vol. lxxiii), whereby three volumes of corpuscles were mixed with one volume of bacterial suspension and three volumes of serum. (For this suggestion we are indebted to Captain Hayden, who had previously reverted to this method for tuberculo-opsonic tests.) (*c*) The use of a staining method peculiarly suitable to autolysed meningococci, e.g., very dilute (0·1 per cent) watery methylene blue after prolonged sublimate fixation.

Further blood examinations of a series of carriers are required to indicate whether the protection of these individuals is brought about by their own anti-meningococcal power or by some other circumstance.

The second hypothesis—which suggests differentiation of the meningococcus of carriers from that of meningitis—would seem a priori unlikely to prove correct, since carriers are usually detected

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[1] *Brit. Med. Journ.*, November 16, 1907.

(and considerable numbers of them are only detected) among those who have been in contact with definite meningitis cases; groups of normal individuals, or random samples of the population, showing at most one per cent or two per cent of such carriers.

The laborious investigation now being carried on by Major M. H. Gordon and his co-workers, with the method of agglutinin absorption (*vide* preliminary report in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October, 1915), bids fair to place beyond doubt the true relation of carried meningococci to those of actual meningitis.

So far as the work has yet gone, it does not suggest any fundamental distinction between the two groups.

The third suggestion now remains for us to consider—that the meningococcus of carriers only differs from that of meningitis in respect of virulence, this becoming attenuated during the microbe's stay in the naso-pharynx.

We are unaware of any experimental demonstration of such a change, and, for want of a method, have not sought it.

Inoculation experiments will not serve (unless perhaps the higher animals are employed) owing to the difficulty of producing meningitis in laboratory animals.

Apart from direct evidence, however, there are certain considerations which make the suggestion plausible. We have been struck by the absence of signs of a naso-pharyngeal infection in most of the carriers under our charge; the tissues have retained a normal appearance, and symptoms of post-nasal catarrh did not occur. Two or three of the cases had an old-standing mild catarrh of the nasal mucous membrane, productive of some morning muco-pus discharged through the anterior nares, but this condition was not apparently aggravated at all by the arrival of the meningococcus in the naso-pharynx, *and that microbe did not appear in the secretions.*

In this connexion the records of three carriers, who had been under observation immediately prior to, as well as during, the period of carrying, are especially worthy of mention. These were cases occurring in medical men who had been periodically examined by cultivation from throat swabs, so that the date of their becoming carriers could be fixed within a very few days. There is little doubt that the meningococcus was conveyed to them from other carriers on whom they had made frequent post-nasal examinations without taking any precautionary measures against infection. The establishment of the microbe in them was entirely unsuspected, being unaccompanied by any change in their general health or by

any local catarrh. Like the other carriers we have watched, they continued in good health.

On the other hand, we may note one possible exception to the rule. A carrier became ill with high fever and pain in the lumbar region on the very day on which he was first found positive (he had been swabbed and found negative a week before). He was not under our observation, but we learned that the symptoms gradually gave way to complete recovery in about two weeks. Lumbar puncture was not performed nor the blood examined, so that we are unable to decide whether this was an abortive meningococcal infection or an attack of the somewhat protean influenza prevalent in the patient's district at that time.

The absence of definite signs of a local infection in most of the carriers under our charge, together with the fact that their blood showed none of the changes which usually characterize the response of a patient to meningococcal infection, and the further fact that these carriers appeared to react like normal individuals to meningococcus vaccine, suggests to us that the meningococcus may usually subsist in the naso-pharynx of carriers, not as an infective agent, but rather as a surface parasite living upon the local secretions, i.e., virtually outside the host's body.

If these conditions of its life cause a progressive decline of the microbe's virulence—as may conceivably be the case—we gain at once a probable explanation of the harmlessness and freedom from infection of a large class of carriers, viz., those who acquire the meningococcus, not directly from meningitis cases but from other carriers, and it is possible, although perhaps less likely, that a similar loss of virulence may often overtake the microbe when present in the naso-pharynx of meningitis patients, before it is transferred thence to the carriers who do acquire it directly from them. Such a supposition would help to explain why the many carriers of that category do not get meningitis at the outset of carrying.

Loss of virulence during a phase of existence outside the human host has not been here considered, as the delicacy of the microbe makes such a phase almost inconceivable.

Reference has been made above to the multiplication of carriers by the passage of the meningococci from them to normal individuals.

The frequency of that event was brought home to us in the early days of our experience of this subject.

Two medical men who were engaged in swabbing carriers

almost daily without wearing protective masks, gave positive swabs after ten and fourteen days respectively.

This led us to inquire somewhat closely how the meningococcus was disseminated by carriers.

Handkerchiefs were suspected at first, but we soon found to our surprise that the microbe was very seldom present in the anterior nasal secretion of carriers. In their saliva, too, it was only exceptionally found, and then in very small quantity—a circumstance which is probably related to the yet unpublished fact determined by Major M. H. Gordon that saliva strongly inhibits the growth of meningococcus on artificial media.

Again, the possibility that the microbe might be carried out into the expired air through the nose appeared unlikely, for no colonies of meningococcus grew on a moist plate of medium which had been held directly under the nostrils of a carrier breathing heavily for several minutes.

With explosive expiratory efforts, however, we had different results. Sneezing directly on to a plate gave many colonies of meningococcus, and two out of five carriers directed to cough at a plate held vertically at a distance of about a foot produced one or more colonies.

It seems probable, therefore, that the microbe is dislodged from the naso-pharynx with some difficultv, and that if carriers will take the simple precaution of coughing or sneezing into a handkerchief, or, better still, a piece of butter muslin, which can be at once burned, there is little likelihood of their disseminating the microbe.

On five occasions we exposed plates in the sitting and sleeping rooms used by a group of carriers, putting them sometimes on the table at which these carriers were seated at a meal or writing, and sometimes near the head of their beds in the early morning, but only once did we recover one or two colonies of the meningococcus on a plate.

The coughing experiments given above suggest that medical men engaged in swabbing carriers or contacts run an especial risk of "infection," and should not neglect to wear some simple mask over the mouth and nose.

Treatment of the Carrier.

His own health calls for no treatment, but so long as he must be regarded as a potential danger, the public welfare and his own

convenience alike make it desirable that he should be rid of the meningococcus as quickly as possible.

Finding no record of any systematic attempt to this end we set out upon the task.

Three lines of attack suggested themselves :—

(1) By active immunization of the carrier (vaccine treatment).

(2) By local application of antibacterial agents.

(3) By replacement of the meningococcus by other microbes antagonistic to it.

Our experience with these methods may be briefly reported in the order given :—

(1) *Immunization.*

At first sight it appeared likely that this was the normal process by which carriers became freed of their meningococci, and that, by appropriate doses of vaccine, one might expedite that event.

One may now question, however, whether these expectations were well founded.

Up to the present, as has already been said, we have been unable to find any evidence of such normal development of immunity in carriers.

And if, as we have come to believe, the meningococcus usually fails to cause any real infection in the carrier, it is unlikely that immunity would be developed.

Further, we have several times observed, in convalescent cases of meningitis, a continuation of the meningococci in the naso-pharynx, even when a high agglutinating and opsonic power had developed in the patient's blood.

It is not surprising, therefore, that the results obtained by vaccine treatment of carriers were in the main unsatisfactory.

Ten carriers were inoculated with a vaccine prepared from seven strains of meningococci (six from carriers and one from cerebrospinal exudate) and killed by heating to 55° C. for half an hour.

A rising scale of doses was employed, culminating in one which gave a slight general reaction.

This corresponded approximately with the doses which Sophian had found to determine in the blood a maximal power of fixing complement.

At first we attempted to control dosage by opsonic records, but these failed us on account of the technical difficulties referred to above.

Of ten carriers inoculated five gave negative swabs within a comparatively short time as shown below :—

T. H. was first found to be carrying meningococcus on the day after prophylactic inoculation (200 millions, subcutaneous); he became free within five days.

After a lapse of some weeks, during which time he was more or less constantly exposed to infection, he again became a carrier.

D. L. had probably been a carrier for several weeks when first inoculated (500 millions subcutaneously); he became free of meningococci a week later.

M. M. had been a known carrier for three weeks when first inoculated (50 millions intravenously). A few days later he received a second dose of 200 millions intravenously, and became free of meningococci within five days thereafter, i.e., within thirteen days after the first inoculation and five or six weeks after the probable date of becoming a carrier.

B. L. had been a known carrier for about two weeks when first inoculated. He became free of meningococci after his fourth subcutaneous inoculation (50 millions, 200 millions, 750 millions, 2,000 million doses), i.e., about twenty-seven days after the first inoculation.

(In this case and the one preceding the final doses caused a slight general "reaction" with rise of temperature.)

It may be noted, too, that the serum of this carrier a few days before he became free gave almost complete agglutination with his own strain of meningococcus up to a thousand-fold dilution —a much higher point than was usually reached.

C. L. became free about two weeks after his second inoculation (1,000 millions, subcutaneous) and three and a half weeks after the onset of carrying, but the time of becoming free also synchronized with a period of vigorous spraying with antiseptic.

The remaining five carriers retained their meningococci for some weeks in undiminished quantity in spite of inoculations a follows:—

Two of them each had five subcutaneous doses ranging from 50 millions to 2,000 millions; two of them had three intravenous doses of 100 millions, 300 millions, and 200 millions respectively, and one had two subcutaneous doses of 500 millions and 1,000 millions.

For purposes of comparison with a group of uninoculated carriers we must omit the records of T. H., D. L., C. L., and one other, and use only the six remaining who were living together

under conditions similar to those of the uninoculated group—conditions which admitted readily of reinvasion by the microbe after a carrier once became free of it.

Of these six, one (" M. M." of the record given above) lost his meningococci within thirteen days after the first inoculation, and another ("B. L.") within twenty-seven days; the remaining four men continued to harbour them for several weeks longer.

Of the uninoculated group of eleven men from the same regiment infected at the same time, two lost their meningococci in the fourth and fifth weeks of carrying respectively, the others retained them much longer.

From this summary it will appear that no very striking advantage, at any rate, was gained by the inoculation; and, incidentally, that the average duration of carrying was, in our experience, much longer than the three weeks of some observers.

In conclusion, it may be noted that subcutaneous inoculation of quantities below 1,000 millions caused little or no general disturbance, and only a moderate local reaction.

Intravenous inoculations above 100 millions caused much more definite disturbance—e.g., rise of temperature, shivering, headache, and a "leggy" feeling—symptoms which always passed away within twelve hours.

(2) *Local Treatment with Antibacterial Agents.*

(*a*) *Antiseptics.*—The choice of antiseptics for trial on carriers was determined by their ability to kill the meningococcus intermixed *in vitro* with nasal secretion, when acting in small volume and in a concentration which would not irritate the nasal mucosa.

The *in vitro* test employed, although rough, gave a useful comparison between various antiseptics acting under conditions somewhat similar to those obtaining inside the nasal passages after spraying.

A loopful of young meningococcus culture was intimately mixed with about half a cubic centimetre of nasal secretion; portions of the latter were then teased out in films on a dry surface of firm agar in Petri dishes; the antiseptic to be tested was then poured over these films and the excess run off.

After a period of exposure to the antiseptic at 37° C. a sample portion of each of the films of nasal secretion was removed, washed in sterile broth, and smeared on a moist serum-agar plate, which was then incubated.

The following results were obtained:—

Antiseptic	Exposure	Result
Protargol, ten per cent watery solution ..	¼ hour ..	Meningococcus not killed
Argyrol, ten per cent watery solution ..	¼ ,, ..	,, ,, ,,
Liq. calcis chlorinata, five per cent (bleaching powder solution) ..	¾ ,, ..	,, ,, ,,
Carbolic, two per cent	¼ ,, ..	,, killed
Silver iodide (one per cent watery suspension of "Argentide") ..	1 ,, ..	,, not killed
Silver iodide (five per cent watery sussion of "Argentide") ..	1 ,, ..	,, killed

Following up these and similar experiments, we tried a three per cent suspension of "Argentide" on several carriers, spraying directly on to the naso-pharynx through an upturned nozzle, and sometimes also through the nostrils into the nasal cavities.[1]

Applications were usually made at frequent intervals (every two or three hours by day), in the hope of checking the multiplication of any unkilled residue of meningococci.

The silver iodide was found to be almost non-irritant, and was effective in so far that it frequently rendered the surface of the nasopharynx *temporarily* free from meningococci, but on discontinuing the spray these reappeared in swabs within one or two days. Moreover, as a result of such treatment (particularly, it seemed, if the nose was sprayed through the nostrils) the invasion by meningococcus was frequently extended to the nasal mucous membrane, the microbes appearing for the first time in the anterior nasal secretions.

In one case such an extension of the meningococcus sphere after spraying was accompanied by a mild nasal catarrh, but whether this was due to the microbe or the iodide is difficult to say.

In only one case out of some seven or eight on whom this procedure was systematically tried for a period of several days did the silver iodide give a permanent freedom from the meningococcus.

With some of the unsuccessful cases it seemed that the meningococcus became more resistant to the iodide, so that not even temporarily could negative swabs be obtained by a second or third course of spraying.

[1] Some care is needed to ensure that the spray reaches the upper naso-pharynx; the soft palate is apt to flap back and occlude the passage. Also the patient should be directed to refrain from swallowing for as long as possible after the application; the deposit of silver iodide was seen to be immediately swept away by this act.

The practice of following up the application of silver iodide by a spray of hydrogen peroxide, which had been recommended as giving rise to the production of nascent iodine on the mucosa, was found to be little or no more effective than the iodide alone, and had the disadvantage of being much more irritant and unpleasant.

The fact that, by silver iodide—and possibly other antiseptics—one can temporarily rid the naso-pharyngeal surface of meningococci suggests that the microbe is wont to establish itself in some situation to which antiseptic applications cannot gain access, and in which it can continue, in spite of these, to reproduce its kind and spread.

It occurred to us that by means of ionization an antiseptic influence might be extended over a wider area of the naso-pharyngeal mucosa, and that if the meningococcus lay hid at the bottom of the crypts among the adenoid tissue it might there be destroyed. With the help of Dr. Wilfred Harris we sought to achieve a like result by embedding a positive electrode in a pad of wool large enough to fill the naso-pharynx and soaked in zinc sulphate. This pad containing the electrode was introduced and secured in the naso-pharynx by a string through the nose, the negative electrode being applied to the arm. A current not exceeding two and a half milliamperes per square inch of pad surface was then passed for ten minutes.

Two carriers so treated showed a marked reduction in the number of meningococci present five hours later, but this effect was only transitory, and no permanent advantage was secured by second and third applications.

A recent criticism of this attempt has suggested that the wool pad surrounding the electrode may well have failed to give satisfactory apposition with all the nasopharyngeal surface, and that such apposition might have been better achieved by the use of a small sac of some slowly permeable fabric, which could be filled with the zinc solution by a catheter through the nose.

(*b*) *Local Treatment by Anti-meningococcal Serum.*—Spraying the naso-pharynx with a specific immune serum has been advocated, presumably on the assumption that the serum was strongly bactericidal for the meningococcus. This assumption would seem to be erroneous.

We have tested the bactericidal value of five anti-meningococcal sera, viz., those issued by the City of New York Laboratory, by the Lister Institute, by Messrs. Mulford, by Messrs. Burroughs Wellcome, by Messrs. Parke, Davis, and also an agglutinating serum prepared at the Pasteur Institute in Paris.

Of these, only the last two possessed any appreciable power of killing the meningococcus *in vitro* (complemented or uncomplemented) ; in the case of one of them, at any rate (P.,D.), the power was little more than that of a watery solution of equivalent strength of the antiseptic (trikresol) it contained. As to the other (Pasteur Institute), it is believed to contain some carbolic acid preservative, but in what strength is uncertain.

One of these sera of highest bactericidal power was also tested after the manner described above for antiseptics and was found to kill meningococci mixed with nasal secretion within an hour.

Its application to the naso-pharynx of a carrier, however, did not effect any diminution in the number of meningococcus colonies yielded by swabs.

(*c*) *Local Treatment by Glycerine.*—It was several times suggested that the hygroscopic property of glycerine might make its application to the naso-pharynx unfavourable to the growth of meningococcus, which likes moisture.

The suggestion was not, however, put into practice, because it was found that the meningococcus would grow abundantly on an agar plate under a layer of glycerine.

(*d*) *Local Treatment by Heat.*—Finding that the meningococcus was killed by a temperature of 51° or 52° C. for half an hour, and that water vapour could be inhaled up to 54° or 55° C. if the skin of the nose was well greased; we tried such an inhalation on two carriers, but did not achieve any notable reduction of the microbes. Nor was any better success obtained by adding volatile antiseptics (menthol and benzoin) to the water.

Replacement of the Meningococcus by Microbes Antagonistic to It.

In the *Lancet* of November 20, 1915, it was pointed out by one of us (L. C.) that the meningococcus is often supplanted in the naso-pharynx—or so it appears—by pneumoccoci or streptococci ; and that these latter organisms are antagonistic to the growth of meningococcus *in vitro.*

On the strength of these observations we implanted upon the naso-pharynx of several carriers (by spraying) a virulent culture of pneumococci and streptococci, in the hope that they would establish themselves there and bring about the extermination of the meningococci.

The event showed, however, that, even when the culture of streptococci had been obtained from the carrier's own saliva,

those organisms did not usually succeed in "taking root" upon the naso-pharyngeal mucous membrane—and the meningococci were therefore not replaced.

Summary.

(1) Possible explanations of the comparative harmlessness of carriers are considered. The evidence available is insufficient for a decision between them.

(2) Signs of naso-pharyngeal catarrh were wanting in most of the carriers observed.

(3) The meningococcus is disseminated by carriers in the acts of coughing and sneezing, but probably not by quiet breathing and speech, and seldom by means of handkerchiefs.

(4) Several different methods were employed for the treatment of carriers, but all alike proved, for the most part, ineffective.

It is doubtful whether the immunization of carriers may be expected to influence their meningococci. The inoculation of a group of carriers with vaccine showed no very striking advantage.

Antiseptic applications to the naso-pharynx usually fail to get rid of the meningococcus—probably because some of the organisms lie out of reach of all such applications.

Although negative swabs were sometimes obtained for a short time after the use of antiseptics (e.g., silver iodide), the meningococcus was recovered in large numbers after the lapse of one to four days. The vigorous use of antiseptics greatly favours the dissemination of the meningococcus by causing an extension of the "infection" from the naso-pharynx to the nose proper, whence the organisms are discharged in the anterior secretions.

Local treatment by ionization and by specific serum was also ineffective.

(5) Reference is made to a recent paper (*Lancet*, November 20, 1915), in which the operation of bacterial antagonism is suggested as the natural process by which the carrier condition is brought to an end.

Our thanks are due to Captain S. R. Douglas, I.M.S. (Retired), for his help in the preparation of this paper.

A STARCH MEDIUM FOR THE IDENTIFICATION OF THE MENINGOCOCCUS BY ITS SUGAR REACTIONS.

By H. W. C. VINES, B.A.

From the Cerebrospinal Fever Research Laboratory, First Eastern General Hospital, Cambridge.

(Report to the Medical Research Committee.)

During the outbreak of cerebrospinal fever in the winter and spring of 1914-15 a considerable number of strains of various Gram-negative diplococci were kept under cultivation and thoroughly studied at the Research Laboratory of the First Eastern General Hospital equipped by the Medical Research Committee. The accepted methods of differentiation of the meningococcus from other organisms of the group were not found in all respects reliable. The fermentation of sugars was ultimately found to be the most satisfactory method of identification, but great difficulty was experienced in preparing a uniform and reliable sugar medium regularly and invariably. Owing to the delicacy of the organism complex sugar media are necessary. The essential factor of such a medium is the addition of fresh serum, blood or tissue extract, added aseptically in relatively large amount after the other constituents of the medium have been mixed and sterilized. The most obvious disadvantages of this method are the risk of contamination either from the air or the serum, and the unknown properties of the serum added. The latter may have a considerable inhibitory effect on the growth of the meningococcus, thereby rendering the medium useless. The reactions of the group are such, that often three or four days' incubation is necessary before definite acid change appears, and the change itself is often so comparatively slight as to be uncertain, unless rigid controls are used. It is therefore essential that the preparation and sterilization of the medium should not interfere with its colour. During sterilization the litmus sometimes decolorizes completely, or changes to a dirty green, and ceases to be of value as an indicator. The reaction of the medium often changes over to the acid side, giving a claret-red acid medium which prevents growth. In other cases the colour has remained good but the organisms fail to grow. During incubation colour-changes frequently occur: the blue colour fades, the litmus becoming unreactive, or there is a gradual progression to the acid side in the controls, though these remain sterile. It

has been found almost impossible to prepare two consecutive batches of serum-sugar medium which are exactly similar in colour and time of reaction and are also favourable to the growth of the meningococcus.

Wedder's starch medium has been found by Flexner to be valuable for preserving strains of meningococci for considerable periods without the necessity of daily subculture; a statement which has been fully confirmed in this laboratory. This medium contains no blood, serum, or tissue extract, and is easily prepared and sterilized. As starch is apparently the deciding factor for growth of the meningococcus in this solid medium, a series of experiments were commenced with the object of introducing starch into liquid media in place of fresh serum.

Simple aqueous solutions were at first used. In a medium made up with water containing 1 per cent peptone, 1 per cent glucose and 1 per cent starch, the meningococci obtained by lumbar puncture failed to grow; the other Gram-negative diplococci, however, obtained from the swabs of contacts, gave their proper reactions and grew on subculture. Meat infusion was then introduced as a basis for the medium instead of water, with promising results.

This series was then repeated with similar results, and finally a medium was obtained which proved to be satisfactory, both as regards growth and reaction. It has the following formula:—

Starch	10 grammes.
Sugar	15 ,,
Beef peptone	10 ,,
Sodium chloride	5 ,,
Infusion of bullock's heart	1,000 c.c.

A litre of meat infusion is prepared in the usual manner: 10 grammes of cornflour starch are ground up in a mortar with a small quantity of this, and slowly added to 200 c.c. of the original infusion, which has meantime been raised to boiling; the boiling should be continued during the addition of the starch, in order to break up the starch grains. The starch suspension is then heated in the autoclave at 20 lb. plus pressure to the square inch for twenty minutes, and is then added to the main bulk of the infusion. To the whole is then added 10 grammes of beef peptone, 15 grammes of the required sugar, and 5 grammes sodium chloride. When these are dissolved, the medium is made + 0·2 per cent acid to phenolphthalein, and a sufficient quantity of filtered saturated

solution of litmus is added to produce a deep blue colour. The whole is then thoroughly shaken, tubed off at once, and sterilized in the steamer for twenty minutes on three consecutive days. Prepared in this way 5 c.c. of the medium should show well-marked acid change to one drop of 5 per cent acetic acid; this serves as a rough test of its sensitiveness.

During sterilization a partial decolorization of the medium may occur, but, on cooling, the colour returns completely and remains constant. No colour change occurs in the controls during incubation, and the litmus retains its full reactive powers.

The advantages of such a medium are the following: It is easily prepared and easily sterilized with minimum risk of contamination, and can be repeated without fail. It gives constant results as regards colour during preparation and incubation, and colour change due to sugar fermentation becomes apparent at an early stage, and increases to a maximum.

The starch must always be autoclaved, as commercial starch frequently contains the spores of a bacillus, which do not appear to be affected by steaming in the ordinary way. This bacillus appears in the medium about the third day of incubation, or, later, destroys the meningococcus and inhibits any fermentative reaction.

This medium has been separately tested with strains of the meningococcus and also with other groups of Gram-negative diplococci, namely, *Micrococcus pharyngis siccus*, the Flavus Group, and *M. catarrhalis*, using four sugars—glucose, saccharose, mannose, and lævulose in 1·5 per cent concentration. In all cases subculture on to nasgar slopes has been performed on the second day after sowing and satisfactory growth has been obtained.

The differentiation of the meningococcus from the other groups of Gram-negative diplococci in this medium is satisfactory. Glucose is fermented by all members of this series of organisms except *M. catarrhalis*, which shows no acid reaction with any sugar, the medium becoming markedly alkaline on the control. Saccharose is not fermented by the meningococcus, alkalinity appearing on the third day of incubation. Lævulose is fermented to a slight degree by the meningococcus. An acid reaction is appreciable on the second or third day, but this is then replaced by an alkaline reaction. The acid reaction is relatively slight, and is markedly different in degree from that shown by the other sugar-fermenting Gram-negative diplococci. Mannose is not appreciably fermented by the meningococcus; a faint acid reaction may occur which quickly becomes alkaline. The reaction of all other members of

the group except *M. catarrhalis* with this sugar is slight but appreciable in this medium. In serum media containing mannose there has been considerable variation of reaction. When the sugar was first used, reactions as good as those of glucose were obtained. Later, however, there has been extreme difficulty in certain samples of serum media in obtaining either satisfactory growth or reaction.

Though this starch medium has only been tested for a month, yet the results obtained point to its value in differentiating easily the groups of Gram-negative diplococci.

The work was undertaken with the assistance of a research grant from the Medical Research Committee.

Royal Army Medical Corps, 3rd Corps Medical Society.

A MEETING of medical officers of the Corps was held on November 6, 1915, at No. — Field Ambulance, seventy being present. It was resolved (1) to constitute themselves into a Medical Society.

(2) That Colonel Bruce Skinner should be President.

(3) That Major E. Alderson should be Hon. Secretary, with Major J. H. Conway and Lieutenant C. D. Pye-Smith to assist.

(4) That ordinary meetings be held at 3 p.m. on Saturdays fortnightly from this date.

(5) That the proceedings be submitted to the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for publication, if an understanding can be come to that speakers have the right of reproducing reports of their remarks.

(6) That offers of papers to be read before the Society be made to the Hon. Secretary.

Lieutenant H. H. SAMPSON then gave a short address on penetrating wounds of the abdomen in war, in which he said: Abdominal wounds differ according to the mode of production. Bayonet wounds are rarely seen and must be rapidly fatal. The only case admitted to this Hospital, that of a private who fell on his own bayonet, arrived with the omentum protruding through the wound. The abdomen contained a fair quantity of free blood but the omentum was the only injured structure. The affected portion was excised and the patient made an uninterrupted recovery.

Gunshot wounds claim the large majority of these cases, and, if the intraperitoneal course is of any length, produce more extensive injuries. It is remarkable how much damage can be done to intestine by a rifle bullet. The gut may be completely torn across in several places. Solid organs may be split open in all directions; a specimen of a kidney was shown where a bullet has passed through the hilum, severing the artery and vein, and causing radiating lacerations of the whole organ.

Particular stress is laid on the tendency of these wounds to bleed profusely. This is of importance because the large majority of the cases die of primary hæmorrhage.

The severity of these wounds may be attributed to the short range and consequent unstable equilibrium of the bullet. A bullet that is almost spent will drill a small hole through soft tissues.

From a clinical point of view it is convenient to divide the cases into four groups.

The first group consists of cases with entrance and exit wounds

indicating a considerable intraperitoneal course in the area occupied by small intestine. The commonest cause is the rifle bullet. These patients arrive in a collapsed condition with signs of internal hæmorrhage. The radial pulse is often imperceptible. Multiple perforation of the small intestine and its mesentery are present. Fortunately, the injuries are usually confined to one segment of the bowel and it is generally possible to include them all in one resection.

The second group includes the abdomino-thoracic cases. There may or may not be injury to lung and pleura. The small intestine is likely to escape. The liver, stomach, colon, spleen and kidneys are the organs which may receive injury. The general condition of these patients on admission is much the same as in the first group. Bullets and shell fragments appear to be the common causes.

In the third group are placed wounds of the back and buttock, with either an entrance wound only or with an exit wound which does not implicate the anterior abdominal wall. Shrapnel bullets and shell fragments are the most frequent causes. In this group difficulties in diagnosis frequently arise. The kidneys, colon, spleen, or liver are the organs most likely to be injured by a wound in the back. The small intestine, colon and bladder may all be injured by a buttock wound which penetrates the pelvic cavity.

The fourth group contains injuries to the anterior abdominal wall with entrance and exit wounds in such a position that peritoneal perforation at first sight appears doubtful.

If injury to an abdominal organ is suspected, the wound or wounds should be explored under an anæsthetic as soon as possible after receipt of the injury. If uncertainty still remains, exploratory laparotomy should be undertaken.

In making a diagnosis, it is unwise to pay too much attention to a good general condition; for it is in those cases where the intraperitoneal damage is slight and the general condition remains good for several hours that the best results will be obtained by prompt operative measures.

Turning next to treatment, one has to decide whether expectant treatment is ever justified when it is evident that an abdominal organ must have been injured. The only cases which have recovered without operation in this hospital have been the abdominal-thoracic variety where the liver and possibly the stomach were the only abdominal organs which could have been injured. In these cases the general condition remained good and the general abdominal symptomswere absent.

Everyone has probably heard of instances during the South African War where abdominal wounds, in such a position that visceral injury might be presumed, have been treated without operation and recovery ensued.

It will be interesting to hear if any members of this Society have seen similar cases during this campaign. During the first nine months of the

War I made constant inquiry of surgeons attached to military hospitals in England, as to whether penetrating abdominal wounds passed through their hands.

The only cases I found were those with large shell wounds of the loin or buttock with fæcal fistulæ, that is, local intraperitoneal damage with free drainage from the time of injury.

Considering next the principles of operative treatment, it must be borne in mind that primary hæmorrhage is responsible for death in the large majority of the fatal cases. Therefore, it is most important that an abdominal wound should reach hospital in the shortest possible time.

A warm theatre and heated operating table are desirable. A free incision is essential, as the first objective is control of hæmorrhage. From the time of the receipt of the injury until the patient comes under the influence of the anæsthetic, bleeding is retarded to some extent by abdominal rigidity. As soon as the peritoneum is opened there is a sudden decrease of intra-abdominal tension, hæmorrhage is encouraged, and the patient, already depleted, may rapidly bleed to death. It occurred to me that compression of the aorta above the cœliac axis could be affected by an instrument pressing over the gastro-hepatic omentum. For this purpose a narrow-bladed retractor, protected by rubber, is used. It is maintained in position by an assistant until the hæmorrhage is judged to be under control.

The injuries are then investigated. With regard to the small intestine, nothing short of a systematic examination from cæcum to duodenum will prevent a small perforation being overlooked. The large intestine is examined by inspection. Its injury is usually suggested by a fæcal odour. Injuries to solid organs are detected by palpation.

In the treatment of these injuries, rapidity of execution determines the method to be adopted. In the case of small intestine resection of the affected portion is generally necessary. Small perforations may be sutured and invaginated, but the damage is usually too extensive to permit of this being done. The edges of a perforation in the intestine are liable to slough and if suture is attempted the edges should be excised.

Injuries of the colon may occasionally be dealt with in this way. The general condition of the patient and the presence of other injuries usually necessitate the more rapid method of bringing the injured portion through the abdominal wall and the insertion of a Paul's tube.

Wounds of the stomach can usually be dealt with by suture and invagination.

Injuries of the spleen or kidney are usually treated by excision of the organ. Wounds of the liver seldom admit of suture and are treated by gauze packing.

With regard to the toilet of the peritoneum; irrigation with saline,

followed by dry-mopping, is probably the best method. If the large bowel is uninjured much time will be saved by leaving the blood *in situ*. A suprapubic drain is inserted.

In the after-treatment, the great difficulty is to get the patient safely over the initial shock and loss of blood. Morphia and salines are used freely. Direct or indirect transfusion of blood would be a great help at this stage and any suggestions of a simple technique will be welcomed.

So long as the patient is in a fit condition to bear an operation it cannot be decided that a case is hopeless. The patients are usually in such distress that an anæsthetic is welcomed.

Colonel CUTHBERT WALLACE followed and made the following observations: The frequency of "abdominal wounds" is under 2 per cent and therefore the frequency of penetrating wounds is very much less. The mortality at the Field Ambulances is 30 per cent and that of the clearing stations 56 per cent. The total mortality at the front is most probably about 70 per cent. The least dangerous wound is an antero-posterior one in the epigastric region to one side or other of the midline. The most dangerous wounds are side to side wounds below the umbilicus, antero-posterior wounds in the hypogastrium, and vertical oblique wounds entering the pelvis from the buttocks. A rise in the pulse and a hardening of the belly wall usually occur within a few hours (three to five) of the receipt of the wound, but these should not be waited for if in the opinion of the surgeon there is a probability of penetration. The abdomen should be opened on principle.

Bullets cause as severe injuries as shell fragments and often completely divide the hollow viscera. Injuries are seldom simple and may involve as much as nine feet of intestine. Stomach wounds are often long slits in the coats of the organ, and no exception should be made in cases of suspected stomach wound. Small perforations could be easily closed, and large holes must be closed. Possibly the non-pouting of the stomach mucous membrane, by allowing the peritoneum of the abdominal wall to settle down on the opening, was a factor in the spontaneous cure of stomach wounds.

Intraperitoneal colon wounds did well. Extraperitoneal cases were much more dangerous on account of the infection of the retroperitoneal tissue; an artificial anus, with or without a proximal colotomy, and free drainage, was the best treatment. It was proved by operation that missiles could traverse the small gut area without wounding the viscera. This most probably was the explanation of the success of the "rest and starvation treatment" in penetrating wounds of the abdomen. Hæmorrhage was the greatest bar to successful war surgery and it was more on account of hæmorrhage than of infection from the opened bowel that rapid transit to the operation table was necessary. The systematic treatment of abdominal injuries by operation had not been in operation sufficiently long for the compilation of statistics about wounds of

different viscera, but the results so far were exceedingly good and encouraging. No one who had had experience was in doubt as to the wisdom of the step that had been taken.

The discussion was opened by Lieutenant-Colonel A. D. Soltau, who referred to the experience of No. 25 Field Ambulance during the period of expectant treatment. In the months from November, 1914, to the end of May, 1915, eighty-three cases of abdominal wound had been dealt with, with a recovery rate of forty-eight per cent, that is to say, a recovery rate in so far as these patients had been transferred to casualty clearing stations. The usual time of retention of such cases was from five to seven days. Whilst in view of charts shown by Colonel Wallace it was impossible to state definitely from the locality of entry and exit wounds that viscera had been injured, yet the sites of the two wounds made it, in certain cases, incredible that none of the viscera had been touched.

From post-mortem examinations of cases dying in the Field Ambulance, the statements by Lieutenant Sampson as to the frequency and the amount of intra-abdominal hæmorrhage were fully confirmed. The speaker had in several cases been unable to locate the source of the hæmorrhage, which he considered must add greatly to operative difficulties, especially in cases of retroperitoneal hæmorrhage.

The so-called explosive effect of bullets having been mentioned by Lieutenant Sampson, the speaker suggested that turning of the bullet on its short axis was a more important factor, especially in the first 500 yards of trajectory, when impact with any resisting body was likely to swing the bullet end foremost. Post mortem, several bullets had been found so rotated. The administrative problem of the rapid transference of such cases to the special hospital had also been raised, and the speaker considered that three to four hours was the average time that would elapse between wounding and operation. He hoped that some speeding up might be found possible, seeing what a strong case for the saving of time had been put forward by Lieutenant Sampson.

It was disappointing to hear that pituitrin had not realized the expectations based on its use.

The following officers also spoke: Captains H. G. Janion, I. C. Maclean, R. Burgess, Major A. C. Osburn, Colonel E. W. Slayter, and Lieutenant-Colonels A. M. Thomson and R. Pickard.

The President observed that in order to expedite the transit of abdominal cases it was not necessary to detain them anywhere with the object of entering them in the admission and discharge book—they would be entered duly on arrival at Field Ambulance. He then concluded the meeting by asking for a cordial vote of thanks to Lieutenant Sampson for his remarks and to Colonel Wallace for his observations and for having taking the trouble to come from a distance to the meeting.

This was carried by acclamation.

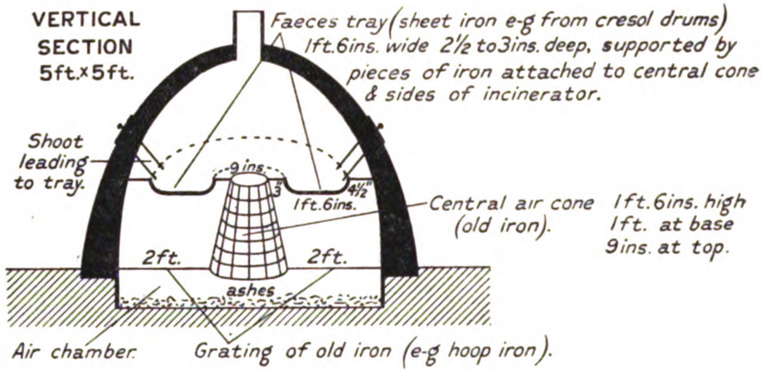
Clinical and other Notes.

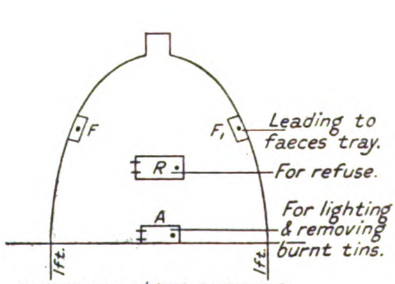
AN INCINERATOR FOR BURNING HUMAN FÆCES AND OTHER CAMP REFUSE.

By Lieutenant A. J. TRINCA, M.D.
Royal Army Medical Corps.

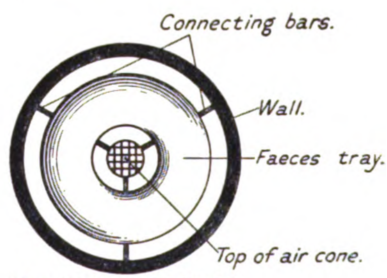
This incinerator is built on the beehive pattern and as its main principles has a subterranean air space for draught, a central air cone, and at the level of the top of air cone, and close to it, a perforated tray for burning fæces.

The following rough diagrams illustrate these principles :—





EXTERNAL VIEW SHOWING DOORS REQUIRED



HORIZONTAL SECTION

The walls are made of brick, stones, or similar material cemented together with a mixture of clay five parts and cow manure one part, the addition of the latter making the mixture very binding, and to some extent limiting cracking by heat. Having the air space below ground saves a large amount of building material that in most incinerators is used up to construct the walls surrounding the air space above ground.

The subterranean air space gives just as good a draught as any other

and with an open air cone above its centre produces a draught, when inflammable material, such as wood or paper, are being burnt, almost as great as in a blast furnace. A zone of intense heat is produced immediately around the air cone, and on this rests the fæces tray. The fæces are rapidly dehydrated and charred and ultimately catch fire. The perforations in the tray allow cresol, urine, and liquid fæces to percolate through on to the bed of manure and fuel beneath, which absorbs them. In the zone above the air cone, gases and smoke arising from burning and destructive distillation of the contents are burnt, and what escapes from the funnel is practically only steam, and soon is dissipated into the surrounding atmosphere, so that the incinerator is not one that reveals its presence through smoke.

The first model built was a small one with an inside diameter of four feet six inches at the base and four feet six inches high. It was only really built as an experiment to test the heat and draught produced, but we found afterwards that it was sufficiently large to successfully cope with all the ordinary refuse, dressings, and fæces from the Field Ambulance, together with the manure from fifty-six horses.

The only disadvantage was that the fæces tray was somewhat small and necessitated three separate burnings to destroy the amount of fæces resulting from our personnel and at that time daily average of eighteen patients. Since that time another has been built with an increase of six inches in all directions, i.e., five feet in diameter at the base and five feet high and the increased cubic space has allowed a tray to be built sufficiently large to hold all the fæces passed in twenty-four hours by the personnel and a much larger number of patients than formerly.

Some attention and common sense are required to work the incinerator properly, but a special man of the sanitary squad can easily be trained in its method of use and kept on that work.

The procedure is as follows: A layer of the more combustible refuse, e.g., papers, dressings, &c., is introduced through door R, then old jam tins and on top of them manure. The fæces are poured in through special shoots through doors F and F 1, and evenly distributed over the tray after the refuse has been ignited and is burning freely. If there be sufficient refuse and manure the incinerator can be kept burning indefinitely, and always ready to receive fæces or soiled dressings. In the latest built a cylinder of water has been built in alongside the funnel, so ensuring a constant supply of boiling water for hospital use.

To sum up, the advantages claimed are:—

(1) Refuse, the only fuel needed.

(2) Large amount of material burnt in small space.

(3) Will consume manure and fæces.

(4) Absence of smell and minimum amount of smoke.

(5) Conservation of space and material by having a subterranean air-chamber.

A NOTE ON FOUR POST-MORTEM EXAMINATIONS IN WHICH RUPTURE OF THE INTESTINE WAS FOUND, ALTHOUGH THE COURSE OF THE PROJECTILE WAS EXTRAPERITONEAL.

By Captain W. C. B. MEYER, Lieutenant J. W. DEW, and Captain A. STOKES.

Royal Army Medical Corps.

During the last three weeks a series of cases has come to our notice in the course of making routine post-mortem examinations which may be of interest to medical officers in charge of wounded. In two of the cases the projectile had exposed the peritoneum without injuring the membrane, and the surgeon was therefore deterred from doing a laparotomy which he would have otherwise undertaken. The other two cases were not considered fit to undergo an operation. In each case the post-mortem examination revealed a contusion of the peritoneum—localized hæmorrhage —without any rupture being found, and yet there was a lesion of the intestine and an extravasation of the intestinal contents.

Case 1, under the Care of Lieutenant J. W. Dew; Post-mortem by Captain A. Stokes.

There was an extensive wound of the lower part of the right abdominal wall about four inches square; the projectile had exposed about two inches of the peritoneum, and the cæcum was apparent through the membrane. The wound extended down to the crest of the pubic ramus, and the periosteum was stripped off the bone; the fragment was not found as it had become embedded in the muscles of the thigh. At the operation the peritoneum was carefully examined and, no opening being found, nothing more than a cleaning and draining operation was performed. Signs of peritonitis developed in two days, and he died on the third day.

Post-mortem.—The peritoneum was found to be intact, care being exercised to determine this point, and no lesion could be found.

There was localized pelvic and right iliac peritonitis, in no way generalized, but localized in pockets between the coils of intestine and sealed off by the omentum. The small intestine was much distended. A portion of the ileum about two inches long was found, which was a dark plum colour and had lost its tone; in the centre of this piece of intestine was an oval tear, this was about six inches from the ileo-cæcal junction; the cæcum was bruised and discoloured. All the other organs were normal.

Case 2, under the Care of Captain W. C. B. Meyer; Post-mortem by Captain A. Stokes.

Bullet wound of the left buttock one inch below and three inches internal to the tip of the great trochanter; exit explosive in the left groin, making an elliptical wound, exposing the inguinal region below and above Poupart's ligament.

Operation consisted in removal of the left testicle and the cleansing and draining of the wound; no lesion of the peritoneum being found, a laparotomy was not performed, although that was the original intention of the surgeon. Symptoms of peritonitis set in on the second day and the patient died on the fourth day.

Post-mortem.—Marked peritonitis was found in the pelvis and left flank, to which regions it was localized. A tear of the bowel was found about nine feet from the cæcum; the intestine for a short distance round the tear had the appearance of a loop of gut taken out of a strangulated hernia, being partially gangrenous. There was no other abdominal lesion found and all the other organs were normal. There were a number of small hæmorrhages round the internal abdominal ring, and a generally bruised appearance of the peritoneum was noted. The peritoneum was intact, and prolonged search for a point of entry of the bullet failed to reveal any such point.

The course of the bullet was traced from behind forwards, and it was found to have passed between the pelvis and the neck of the femur; it had just grazed the lower border of the acetabulum, from which small splinters had been torn off and were found lying in the track of the bullet.

The man was hit while in the squatting position when he was repairing wire entanglements.

Case 3, under the Care of Captain W. C. B. Meyer; Post-mortem by Captain A. Stokes.

A man shot through the left buttock at the junction of the posterior and middle thirds of the line joining the anterior and posterior spines of the ilium. Exit wound two inches by one-and-a-half inches, elliptical in shape, in a corresponding place in the right buttock, immediately above the great trochanter.

Man admitted in a state of extreme collapse and died in a few hours.

Post-mortem.—Peritoneal cavity contained a large quantity of fluid intestinal contents which had escaped from a small tear of the small intestine; this tear was situated at the mesenteric margin of the bowel, about six inches from the cæcum. There was only one wound of the bowel, and if it had been done by the direct contact of the bullet there must have necessarily, from the position of the tear, have been two wounds. There was no blood in the cavity. A small muscular tear of the pelvic colon was found, but the peritoneum over the tear was intact and a small bubble of gas that had escaped through the tear was seen under the peritoneum and could not be forced out. The bullet track was found to pass across in front of the sacrum, exposing bare bone; there was some retroperitoneal hæmorrhage. No perforation of the peritoneum could be found, though a point of entry was carefully looked for.

CASE 4, UNDER THE CARE OF LIEUTENANT J. W. DEW; POST-MORTEM BY CAPTAIN A. STOKES.

Man admitted pulseless and vomiting; died within a few hours. Wound on the right buttock, about two inches internal to the tuber ischii, with the track leading across the middle line to an exit wound in the lumbar region on the left side of the third and fourth lumbar spines two inches from the middle line. The exit wound was lacerated, circular, and of four inches diameter. The bullet had comminuted the sacrum and opened the lower end of the spinal canal, had then passed upwards along the groove between the sacrum and the right ilium; a part of the sacrum had been driven forwards towards the pelvis. The abdomen contained some fæces, but there was no intraperitoneal hæmorrhage. Some coils of small intestine drawn up from the pelvis showed evidence of severe bruising, the intestine being of a dark purplish colour.

The pelvic colon had a small tear admitting the top of a pencil; this was situated about five inches above the junction with the rectum.

The mesentery of the pelvic colon was uninjured, but the wall of the bowel showed the same bruised appearance as was noted in the small intestine on each side of the tear for a distance of about two inches. The pelvic peritoneum was not injured and no communication could be found with the wound in the sacral region; there were no foreign bodies, such as particles of bone, in the pelvis. All the other abdominal viscera were normal; the only sign of injury was near the lower pole of the left kidney, where there was some subperitoneal hæmorrhage which had clearly tracked through from the exit wound.

In conclusion, we do not in any way attempt to explain these findings, but only suggest that the results are perhaps due to concussion effects. The conclusion we draw from the series of cases is that the fact of not finding a perforation of the peritoneum is not a contra-indication to laparotomy, more especially when the clinical features point to the presence of some intraperitoneal lesion.

OPEN-AIR TREATMENT FOR WOUNDS.

A SIMPLE AND INEXPENSIVE FORM OF OPEN-AIR WARD, AS USED AT THE V.A.D. HOSPITAL, HENLEY-IN-ARDEN.

BY W. ERNEST NELSON, M.R.C.S.

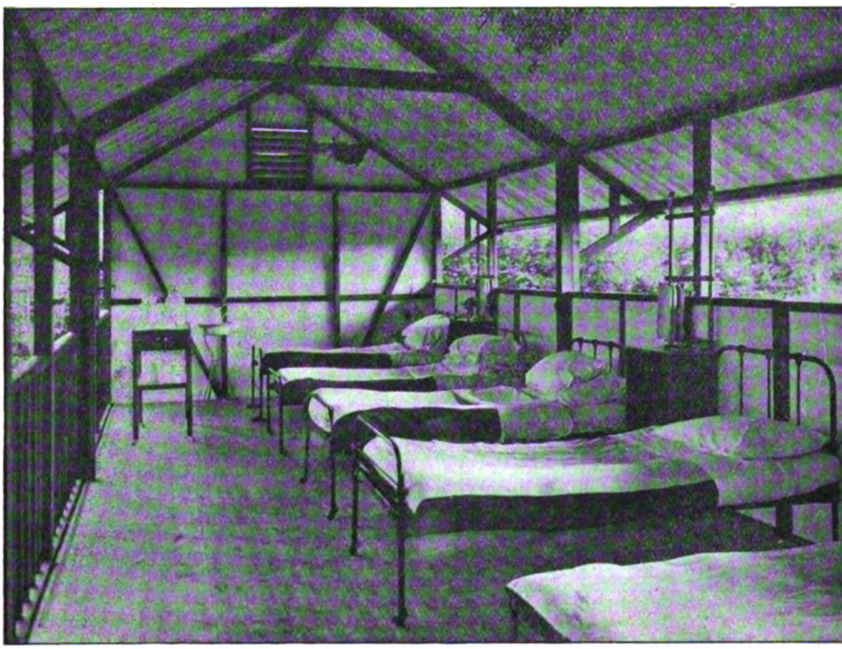
DURING the present War, open-air treatment has played a large part in the cure of wounded soldiers, and any medical man who has had charge of wounded knows what excellent results can be obtained by this method, especially in the more serious kinds of suppurating wounds and in cases of general septicæmia.

In submitting this short account of an open-air ward, I do so because I think it may be of interest, and also because it has one or two features which may specially commend it.

The ward was built for use at the V.A.D. Hospital, Henley-in-Arden, of which hospital I am Commandant and Medical Officer, and is specially adapted for such hospitals, as it has the merit of being cheap and at the same time efficient.

This particular ward has accommodation for eight beds, though I have had as many as nine beds in it at one time, but buildings can be constructed on these lines to take two or three beds or twenty or thirty.

The chief features which I claim for this particular form of building are as follows :—

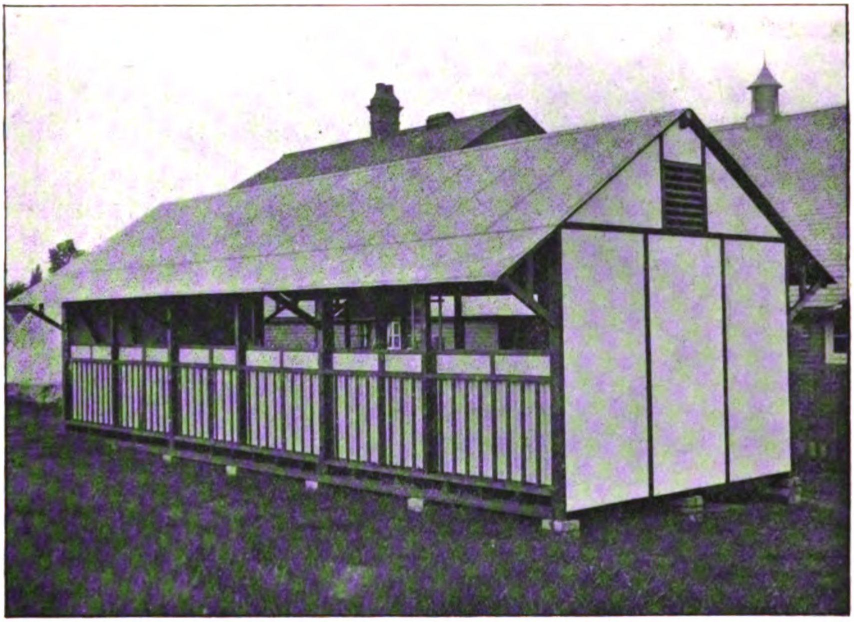


(1) It is open to the air on both sides, the ends only being closed in. Most open-air wards that I have seen are closed in on three sides. The protecting screens, at the back of the bed-heads, seen on the right hand side of the view of the interior, are four feet high and afford ample protection from draught. The left-hand side is open down to the ground, except for an open balustrading. Thus there is a free current of air continually passing over the heads of the patients as they lie in bed, and yet they do not feel any draught.

(2) The deep sloping eaves are set at such an angle that the rain cannot drive in, even on the most windy and rainy days. During July, in which we have not had a single day without rain, and have

had some of the most severe thunderstorms I have ever seen, the interior of this ward has always remained dry and the patients have suffered no inconvenience from wind or rain.

(3) If it is desired to close in one side completely, this is done by a system of spare screens, which either fit into grooves provided or are hinged on to the already existing screens at the back of the beds and are then thrown upwards and bolted to the wall plate or roof. In this way either side of the ward, or both, can be entirely or partially shut in.



(4) It is easily built, the materials being wood and asbestos sheeting, the latter being cheaper than wood, besides having the additional merit of being fire-proof. The roof is of match-boarding, covered with rubberoid. The floor is constructed of boards, tongued and grooved, so that no draught can come through. The whole structure is raised some twelve inches from the ground on small brick pillars; this allows a free air current under the building and at the same time does not kill the grass, should it be found necessary to erect such a building on a lawn or in a field.

(5) It is quickly and easily erected. This particular building was put up complete in four days, or ten days from the date of the order being given.

(6) It is easily connected with the main building of the hospital by

a covered way, so that nurses and patients can pass to and fro in any weather.

I shall be pleased to give further details to anyone interested in the subject.

A CASE OF GUN-SHOT WOUND OF THE HEAD WITH A PIECE OF SHRAPNEL IN THE BRAIN; VALUE OF THE USE OF AN ELECTRO-MAGNET AND X-RAY SCREEN FOR REMOVAL.

By Lieutenant JOHN ROBERT LEE.

Royal Army Medical Corps.

Lance-Corporal W. R., of the 9th Black Watch, "D" Company, received a gun-shot wound on September 25, 1915, in France. The piece of shell entered the skull about the middle of the left temporal region. He had an injection of antitetanic serum four hours after the injury. He was admitted to hospital on October 9. He was conscious, complained that he could not sleep and that he had considerable pain. The superficial wound in the side of the head had healed. The temperature was 99° F., pulse 60. Next morning he vomited.

A skiagram taken on the 11th showed some depressed fragments of the internal table round a small hole in the middle of the squamous portion of the left temporal bone, and the shadow of a piece of shell about half an inch by a quarter of an inch was seen on the plate, one inch behind the hole and one and a half inches beneath the surface.

On the 13th Mr. Leslie Paton examined the eyes (pupils not dilated) and found the right optic disc, highest point + 3D., edges blurred, veins distended, general retina + 5, swelling 2½. Left optic disc, highest point + 5D., general retina + 1, swelling + 4. The patient had sensory aphasia, word-blindness, but no apraxia.

Operation.—A large temporal flap was made and the opening in the skull enlarged; pieces of depressed bone were removed, the torn edges of the membranes were opened up and about two ounces of thick pus under pressure escaped. The piece of shell could not be felt with the probe and a rubber tube was put in and free drainage established. On the 15th another skiagram showed that the piece of shell had dropped farther back in the abscess cavity into the occipital lobe. The temperature at this time varied between 97° and 99° F., but, on the 23rd, the evening temperature was 100° F., on the 24th 101° F., on the 26th 102° F. It then became normal and has remained so ever since. The pulse-rate varied between 64 and 100, and after the 26th has been from 72 to 80. On the 23rd the eye appearances were: right optic disc, highest point — 3·5D. Left optic disc, highest point — 4D.; veins still

much distended. A probe was passed down along the abscess track and a stereoscopic skiagram taken (*see* plate). The fragment of shell was found to be lying in the occipital lobe, one-eighth of an inch in front of the tip of the probe and half an inch mesial to it. A steel probe was then passed down the track, and an electro-magnet, capable of lifting 14 lb. weight, was applied to the probe and held in position for a few seconds, but the bit of shell was not drawn out by this means.

It then seemed to me that one might be able to see the fragment and remove it under the X-ray screen, and, after consultation with Dr. Florence Stoney, the radiologist to the hospital, the attempt was made on November 9. The steel probe was again passed in along the track, and one was able to see quite clearly the probe and the fragment. It was found that the latter had been pulled forward by the magnet and caught in brain tissue. A crocodile forceps was then passed along the track to a depth of four inches, and after some manipulation the piece of metal was seized and removed. The patient was not under anæsthesia, and felt no pain, except just as the sharp edges of the fragment came into contact with the edges of the superficial wound.

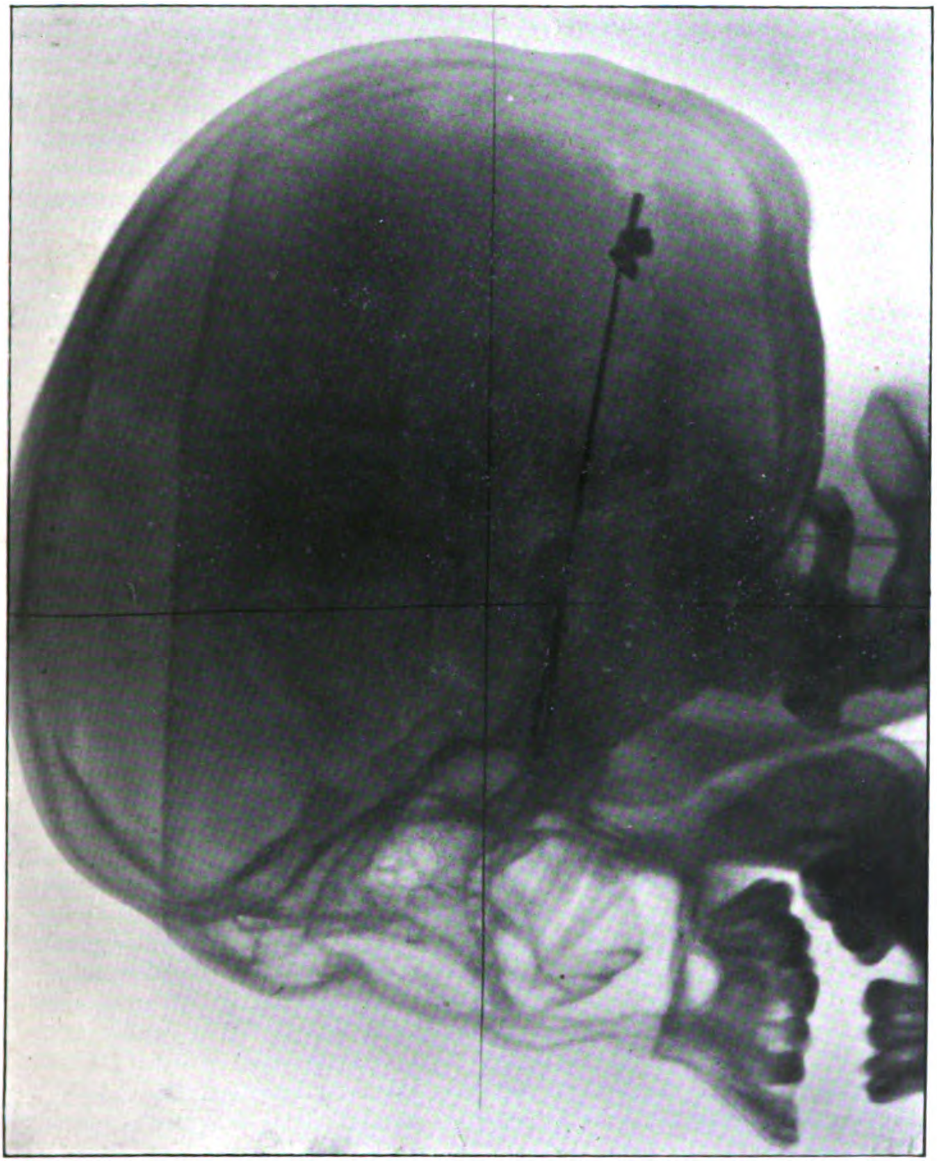
On the 13th the patient's general condition was quite good. On November 17 the wound had healed; his aphasia was less marked; he still had some slowing of mental cerebration and at times difficulty in naming articles, with some loss of memory in naming places and for recent events. The eye symptoms were: Right optic disc still blurred; swelling had subsided very much; highest point of disc, – 2D.; general retina ametropic; small linear hæmorrhages, especially in lower part of disc. Left optic disc still all blurred; subsidence not so marked in appearance as in the right eye; swelling; highest point of disc, – 2D., some hæmorrhages.

The two practical points demonstrated are:—

(1) The use of an electro-magnet for the removal of portions of shell which are capable of being so attracted.

(2) The fact that one can demonstrate bits of metal *inside* the skull, although the X-rays have to penetrate two layers of bone; the surgeon may thus receive very material assistance in such cases by seeing the relationship of fragment to instruments during actual removal.

My thanks are due to Dr. Florence Stoney for the excellent skiagrams and help with the screen; to Dr. Leslie Paton, who kindly worked out the eye conditions; to Major Parsons, the officer in charge, and to Colonel Peterkin, the Deputy Director of Medical Services, for permission to publish this case.



To illustrate "A Case of Gun-shot Wound of the Head with a Piece of Shrapnel in the Brain: Value of the Use of an Electro-magnet and X-ray Screen for Removal," by Lieut. JOHN ROBERT LEE, M.D., R.A.M.C.

Translations.

THE PRODUCTION AND SELF-DESTRUCTION OF DOMESTIC FLIES IN HORSE MANURE.[1]

By M. E. Roubaud.

Horse manure is the best medium for the development of the domestic fly. All the other materials (diverse manures, excrement, liquid manure, sweepings) to which one ordinarily accords a rôle in the production of the fly do not really come into question.

Manure kept only for twenty-four hours in a stable produces in the warm months an average of 10,000 to 20,000 flies per cubic metre; the proportion may even reach 30,000 to 35,000. It is estimated that a horse produces sufficient manure to give rise to the development during summer of 40,000 to 50,000 flies per month, even 160,000 to 200,000 flies during the most favourable season, viz., June and September.

Fresh manure alone plays a part in the production of flies. The laying of eggs even takes place in the stable on the dung impregnated with urine, an indispensable condition. Oviposition may continue for twenty-four hours, but never later. Fermentation, after barely twenty-four hours, definitely protects the manure from the laying of eggs. Antiseptic substances and larvicides (borax, cresol, ferrous and ferric salts), by delaying fermentation, may prolong deposition one or two days. Employed as larvicides these substances, by prolonging the period of infestation, often produce a result the very opposite of that intended. From the sixth day manure when placed in a heap does not contain larvæ, these having migrated to the base for nymphosis. Anti-fly measures, therefore, ought to be taken within five days of the removal of the manure from the stable. Manure twenty-four hours old at the time of the removal does not contain visible larvæ. The eggs which are disseminated throughout the manure heap then open and the larvæ come to the surface, leaving the central parts as fermentation develops and the temperature rises. On the following day a temperature of 70° C. to 90° C. may be found in the centre of the heap. The heat arising from fermentation in a manure heap may be used as a means of destroying the larvæ which it contains. The larva of the domestic fly, protected from the gases of fermentation, dies in three minutes when exposed to a temperature of 50° C. In contact with the gases it dies in one minute at 51° C., in five to seven seconds at 59° C., and four to five seconds at 60° C. When a manure heap is turned over the larvæ which come in contact with the hot parts in the interior are killed at once. A complete stirring

[1] *Comptes Rendus*, No. 11, September 1, 1915.

up of the manure on the day after the deposition, and repeated on the two following days, causes a disappearance of ninety per cent of the larvæ. This operation is more easily and quickly done if, instead of waiting until the infected heap has itself produced the necessary temperature, it is exposed to the heat of a heap previously fermented. For this purpose, instead of placing the new manure on the surface of the heap as is usually done, it should be buried in the hot parts by covering all its surfaces with a layer of hot manure twenty centimetres thick. In four or five hours the new manure may be considered as entirely free from eggs and larvæ, which would otherwise have developed in thousands. This biological method of delarvization by heat is equivalent to the heating of the whole of the fresh manure to a temperature of 50° C. to 60° C., and is effected without apparatus and without fuel. It is within the reach of all and only a simple training of the personnel is required. In practice, it is found that the mass of fermented manure required to furnish the necessary temperature is about eight times that of the fresh manure to be treated. Next day this may be used in its turn as a source of heat. The biothermic method of treating fresh manure can alone destroy quickly and cheaply the eggs and larvæ in a manure heap. The various methods of covering in manure heaps with materials such as earth, straw, &c., can only prevent the flies on the outside from depositing their eggs on the surface of the manure, they cannot hinder the development of the eggs which have been previously deposited on it in the stable. Now these furnish the greatest proportion of the larvæ, and from them, according to my experiments, at least eight thousand to ten thousand flies originate.

THE SUBSTITUTION OF GELATINE FILMS FOR THE USUAL EXPENSIVE X-RAY PLATES.[1]

By Lieutenant G. VILVANDRÉ.
Royal Army Medical Corps.

In the X-ray Department of the Laennec Hospital, Dr. Maingeot uses gelatine "pellicules," supple and non-inflammable, sold under the name of "securitas" films or "pellicules." These are practically made of three parts—the gelatine, support, and a piece of cardboard which adheres to the borders of the gelatine. The cardboard supports the gelatine during the photographic part of the work; without it the film, softened by the different baths, would be creased, deformed and torn. After drying, one removes the borders with scissors, the sheet of cardboard drops and the gelatine remains just as a celluloid film.

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[1] From the *Revue Eléctrique.*

The photographic manipulations are the same as those used with bromide papers. The development is observed either by transparency or reflexion.

Brought before the Académie des Sciences, Landouzy spoke thus of the "pellicules":—

"The great interest from a medical point of view is that under a small volume, small weight and without danger of breakages, one has material for a great number of radiograms. Being much cheaper, more pellicules can be used for many different views and investigations than glass plates.

"Like photographic paper, *these pellicules can be pinned to the chart*, and they also give the inestimable advantage of repeated printing, and the finest details are visible on the films, details lost on printing paper.

"*The pellicule can be moulded to the part* to be radiographed if necessary, whilst the glass plate cannot be used in this manner; *it can be introduced into the mouth or any natural cavity.*

"The pellicule never breaks, either in transit or in use, in contrast to glass plates, which can easily do so when placed against a bony prominence whilst strong pressure or a weight is applied.

"A plate 40 by 50 cm. weighs at least 995 grammes. A pellicule of the same size weighs 80 grammes before the cardboard is removed; but after removal of the cardboard a film weighs 25 grammes, which is only ⅓ gramme heavier than a letter, which is sent for 1d.

"A box containing 12 plates weighs 12 kilogrammes, and the same box can store 50 pellicules, weighing only 4 kilogrammes.

"To be *sent with the patient*, the pellicule is rolled; scissors will remove the useless surrounding part, leaving the interesting portion of the image only.

"From a *storage point of view great gain is obtained*, the bulk being immensely diminished.

"Thus the substitution of a product, light, supple, cheap, sufficiently strong, transparent, homogeneous, non-inflammable, for glass, which is heavy, bulky, breakable and expensive, constitutes a very important advance in the *matériel* of an X-ray department."

Lecture.

GAS POISONING.[1]

By Professor L. HILL, M.B., F.R.S.

The reprobation of the use of poison gases by the Germans in war does not lie so much in their actual use as in the fact that the German Government broke, in this as in so many other respects, their word, and secretly prepared before the war this method of offence.

All the propellants now in use set free enormous volumes of gases. The late Professor Vivian Lewes calculated that one of the 15-inch guns on a super-dreadnought, with its charge of 400 pounds of cordite, gives off about 2,500 cubic feet of carbon monoxide gas each time the big gun is fired. In every battle hundreds of thousands of cubic feet of this gas must be produced, and yet so great is the diffusive power of the atmosphere that no poisoning from it can be traced. Nevertheless, carbon monoxide is a gas so poisonous that the breathing of one per cent quickly renders a man unconscious. The high explosive nitre compounds, such as picric acid and tri-nitro-toluol, set free when exploded not only carbon monoxide but nitric oxide gas, and the latter when breathed has an irritative effect on the lungs closely comparable with that of chlorine.

The fumes of high explosives set free in close spaces, such as cellars and the interior of war-ships, where the ventilating power of the atmosphere is absent, may poison those who are not actually put out of action by explosive violence.

Gas-poisoning, then, to a limited extent occurred in modern warfare before drift gases and asphyxiating shells were introduced by the Germans. Much has been made of the suffering produced by gas poisoning, and truly dreadful to behold is the fight for breath of the strong man poisoned by chlorine; but we cannot suppose that the sum of suffering produced by gas is greater than that inflicted by shell wounds with the attendant sepsis, lock-jaw, and permanent maiming of individuals.

There are poison gases which kill by cutting off the supply of oxygen—e.g., nitrogen and hydrogen, these dilute the atmospheric oxygen below a viable amount, and carbon monoxide, which, by combining with hæmoglobin, prevents the carriage of oxygen to the tissues. There are other gases like cyanogen, hydrogen sulphide, hydrocyanic acid, which when breathed become absorbed into the blood and paralyse the respiratory centre. There is still another set of poison gases which acutely irritate the respiratory passages, causing exudation of lymph therein, which drowns the subject. This last set of gases the Germans have made use of, and for two reasons: first because they put a man out of action when

[1] Read before the Medical Society of London, November 29, 1915.

breathed for a shorter time and in greater dilution than any other poison gas; secondly because they are heavier than air, and so suitable for drifting with the wind.

The molecules of gases, unrestrained by cohesion, are able freely to intermingle, and this diffusive process is very greatly quickened by convection currents set up by differences between the soil and air temperature, by currents due to evaporation of moisture, and still more so by winds and the eddies produced by the friction of wind against the soil. Owing to the immense ventilating power of the atmosphere and the concentration of the poison gas required, the problem of effective use is a very difficult one. The drift gas must be considerably heavier than air, or diffusion will disperse it—gases intermingle at a rate which is inversely proportional to the square roots of their densities; it must not be too heavy, or it will sink to the foot level; the wind must be of the right strength and direction; the gas must poison in a concentration of at least 1 in 10,000, or the quantities required will be unmanageable. It must be borne in mind that a man can hold his breath for at least half a minute, and that the poison gas cloud must therefore last long enough to enforce breathing, and this breathing must continue long enough to put the man out of action. Owing fortunately to the enormous ventilating power of the atmosphere, there is no reason to fear that Zeppelins will drop poison bombs on London. The German High Staff know perfectly well that no real "frightfulness" can be effected in this way. The scare about poison bombs which was prevalent in London some months back was unreasonable, and the sale of respirators, constructed as they were to be worse than useless in a real emergency, was nothing more than a gigantic fraud, against which the public ought to have been warned.

Examination of the back volumes of the *Archives für Hygiene* show that poison gases were investigated in Germany for years by Lehmann and his pupils from the ostensible point of view of making safe dangerous trades. From a critical survey of these papers the conclusion is inevitable that if any gases were used in warfare they would be chlorine or bromine. They alone come up to the requirements, viz.: (1) that a 1 in 10,000 concentration rapidly puts a man out of action, by asphyxiating him, owing to its intense irritative property; (2) is much heavier than air; (3) is manufactured in huge quantities in trade processes; (4) is easily compressible into cylinders for convenience of transport and handling. Moreover, a respirator is easily contrivable to protect the person who manipulates the brigade gas attack. It is obvious that no drift gas can be used offensively from which the users are unprotected. The density of the various asphyxiating gases, which at first were suspected of being used, are: sulphur dioxide, 2·21 times heavier than air; nitrogen peroxide, 3·17; chlorine, 2·45; phosgene, 3·49; bromine vapour, 5·53. The power of liquefying a gas by cold or pressure, or a

combination of the two, enables the chemist to get into a convenient form large quantities of these asphyxiating gases, but the turning of these liquids back into gases may be troublesome, because the heat withdrawn during volatilization may be so great as to freeze the nozzle and stop the outflow.

Special devices are required to produce the expulsion of the gas some distance in front of the trench and to prevent the retardation of flow by freezing. Sulphur dioxide irritates the eyes and air tubes in concentrations of 1 in 2,500; it is liquefied by a pressure of three atmospheres, chlorine by six atmospheres. Of the two, chlorine is a far more powerful asphyxiant, being unbearable in a concentration of 1 in 10,000. Peroxide of nitrogen can be liquefied below 26° C. In comparison with chlorine, used in weak concentrations it has a delayed irritative action on the lungs, and therefore, owing to its want of stopping power, is far less suitable for use. Firemen are sometimes exposed to fumes of nitric acid—e.g., after the bursting of carboys; they are unaffected at the time, but develop a fatal inflammation of the lungs during the next twelve hours. As the oxides of nitrogen play so important a part in the manufacture of explosives, it is unlikely that the peroxide should be used as a drift poison gas. Bromine vaporizes at atmospheric pressures and boils at 59° C. It is far heavier than and as powerful an asphyxiant as chlorine. Germany produces almost the whole of the European supply. It has been said that certain bromine organic compounds have been extensively used by the Germans in asphyxiating and lachrymating shells. The vapours of these substances in concentration as little as one part in several millions of air are said to put a man out of effective action by causing watering of the eyes and inability to open the eyes, so specifically irritating are they to the conjunctiva. They also are said to cause in greater concentrations irritation of the respiratory mucous membrane.

Chlorine can be made very easily by heating a mixture of hydrochloric acid and black oxide of manganese, or by electrolytic processes. It can be stored in lead-lined cylinders. The gas above the liquid chlorine exerts a pressure of at least 90 pounds per square inch, so that all that the Germans required to project chlorine was a long tube projecting in front of the trench parapet and a valve. The spray turns into a yellowy-greenish vapour, and owing to its weight drifts with the wind along the ground. Anyone who has watched smoke from a weed bonfire drift over a field will see how far the chlorine vapour may be carried in poisonous concentration. It will sink into trenches, shell-pits, mine-craters, cellars and dug-outs. To produce a concentration extending 10 feet up of 1 in 10,000 during a period of ten minutes in a wind moving uniformly four miles an hour, over 1,000 cubic feet of gas are required for each 100 yards of front. This is leaving out of account diffusion and the ventilating power of the atmosphere. It is clear, then,

how large a volume of gas is required for an attack, and how any gas which does not come up to the 1 in 10,000 standard must be ruled out.

To estimate the lethal dose of chlorine or bromine special methods have to be devised, because these gases combine very readily with the hair of an animal, turning this into a gummy substance. My fellow-worker, Dr. Benjamin Moore, found that hair dissolved in bromine into a gummy red-black mass from which the bromine could be washed away, leaving a white friable substance. This bromo-protein compound gave an intense violet biuret reaction, and on addition of strong nitric acid yielded up its bromine. The effect of 1 in 10,000 chlorine is such that no man would endure breathing it who could escape from its influence. The eyes and the mucous membrane of the respiratory tract are intensely irritated, and a watery exudation takes place—the inevitable effort which the living tissues make to dilute so irritant a poison. Just as lymph is poured out after a superficial burn of the skin or the application of a blistering fluid, or in a septic wound under the influence of bacterial toxins or antiseptics, so does chlorine produce an exudation of lymph in the lungs. The epithelial lining is damaged by the poison, both that of the mucous membrane and of the capillary wall. The osmotic pressure of the damaged tissue is raised—the celloidal lining complex becoming killed and disintegrated, with the setting free of crystalloidal substance. Thus fluid is pulled out by osmotic forces, while through the damaged capillary wall, too, the plasma may actually leak away. The classical first symptoms of inflammation thus appear, ending in stasis of the corpuscles in the capillaries owing to exudation of the plasma. In the earliest stage the salivary glands in the mouth and the mucous glands in the air tubes are stimulated to secrete, just as the tear-glands flood the eyes. It is this pouring out of the fluid in a vain effort to ward off the poison which causes the asphyxial symptoms of chlorine poisoning and finally drowns the man. He is as surely drowned by the exudation as he is when he breathes water into his air tubes. The mucous membranes of the nose and mouth wet with secretion at first act as a protective respirator, catching much of the poison and preventing it entering the lungs. That this is so is seen by the greater celerity with which serious symptoms arise in an animal when chlorine is administered through a tracheal cannula instead of through the nose and mouth. It is a remarkable fact that while 1 in 10,000 is unbearable to breathe, and 1 in 100,000 is distinctly irritative, yet we find it takes a concentration of as much as 1 in 3,000 of chlorine dissolved in water to stop the movement of the cilia in a preparation of ciliated epithelium observed microscopically. Chlorine is much more toxic when it comes in contact with the moist living membrane in a gaseous state than when in watery solution.

Sir Edward Schäfer[1] has drawn attention to this: "From the

[1] *Brit. Med. Journ.*, August 14, 1915.

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chemical nature of chlorine," he writes, "it seems evident that its immediate action must be local, for it is scarcely possible to imagine that it can exist in the free state in such a fluid as blood, which contains many bodies with which it would immediately combine, and which would —unless it were introduced in immense quantities—at once render it innocuous." When ten cubic centimetres of Ringer's solution saturated with the gas were injected by Schäfer into the jugular vein of a rabbit, in a period of twenty seconds there occurred a quite temporary fall of blood-pressure and increased depth of respiration. Only in one case when the same amount was injected rapidly and with, therefore, less perfect admixture of blood, did œdema of the lungs and congestion result in the pulmonary vessels, producing a fatal result. The irritative effect of the dissolved chlorine is spent on the blood or the lung, the first tissue it comes in contact with. When inhaled, the chlorine spends its effort on the air-passages and lungs, and we have no evidence that free chlorine or any poisonous chloro-protein complex is formed, which, conveyed by the blood, poisons other tissues. Major Walter Broadbent, in a note concerning nephritis following chlorine poisoning, says: "It looks as if in some cases the chlorine or bromine damages the lung epithelium so severely that it does not allow absorption into the general circulation, while in others the gas passes through the lungs without affecting them permanently, but then sets up an acute nephritis."

It is not possible to uphold this theory. Chlorine gas in every case expends its fury on the lungs. The nephritis, I believe, is due to the intense and prolonged dyspnœa and the struggles for breath. Albuminuria is a common result of the very temporary dyspnœa which athletes suffer in a race. It results in such case from the want of oxygen in the kidney, just as it does when the renal artery is temporarily occluded. It is, I believe, the want of oxygen which produces the increased acidity of the blood observed by Dr. Barcroft in a few cases of chlorine poisoning, including a dog experimentally poisoned by us. No doubt the products of the damaged pulmonary tissue, absorbed during the days subsequent to the poisoning, have a toxic effect, particularly as the damaged lungs become infected.

Symptoms.

We are told[1] that a typical case on admission is cold with a subnormal temperature, conscious but restless, with pulse slow and full (except in the collapsed cases). The face is cyanosed—intensely so in many cases—and the expression strained and anxious. The posture varies. In some cases the patient sits propped up, with head thrown back, gasping for breath; in others he lies on his side with his head over the edge of the stretcher in an attempt to aid expectoration. The respirations are jerky

[1] Black, Glenny and McNee, *Brit. Med. Journ.*, July 31, 1915.

and hurried, often numbering forty a minute, and are associated with a choking cough, accompanied by a varying amount of frothy expectoration. With each inspiration the chest is expanded to its fullest, all the auxiliary muscles being brought into play just as in an asthmatical paroxysm.

This is the first or asphyxial stage, which, if the patient survive, gradually passes off after some thirty-six hours. Can we wonder that such long-lasting intense dyspnœa should produce nephritis, accompanied, as it is, with convulsive breathing which just maintains the cerebral circulation within viable conditions at the expense of the abdominal circulation? Major Broadbent records a case where he believes a cusp of the aortic valve was ruptured in the struggles for breath.

"After the first stage the patient falls into a sleep and awakes feeling much better. But after a few hours of comparative quiet, symptoms of bronchitis begin to manifest themselves. In the majority of cases these are not severe." Because, no doubt, nearly all the severe cases die in the first stage. "In the cases which are kept alive with difficulty, there is a short quiescent stage followed by intense bronchitis. The frothing gives place to greenish muco-purulent expectoration, consciousness to delirium; the temperature rises from subnormal up to 104° F., the pulse becomes of small volume with its rate increased perhaps to 160, the respirations are less choking but more shallow, and number up to seventy per minute before death." Post-mortem examination in the acute cases shows intense congestion of the mucosa of the trachea and larger bronchi. These tubes are filled with a thin light yellow frothy secretion, some of which escapes from the mouth and nose when the cases are first laid on the table. The fluid is highly albuminous, solidifying on heating. The larger bronchi only can be traced, the smaller being lost in a condition of intense congestion and œdema which affects the lungs as a whole.

The lungs do not collapse in these acute cases, but appear like a solid cast of the thoracic cavity, and are greatly increased in weight. On incision the lung tissues appear of a deep maroon-red colour, and the exudation flows from the cut surfaces in abundance. Light grey patches are to be seen on the surface of the lungs amidst the congested areas. They were found to be due to emphysema. So intense is the obstruction to the entry of air, and so violent the efforts of respiration, that emphysema is produced in these least poisoned parts where air can still enter. We can picture how the violence of the respiratory efforts, brought to bear on a relatively few small parts of the lungs, distends and breaks down the walls of the alveoli, expelling the blood into surrounding congested areas.

The parts of the lung tissue not affected by emphysema show intense congestion of the capillaries, and many of the alveoli are seen filled with exudate, which takes on the eosin stain. Into some alveoli red corpuscles escape, and larger patches of hæmorrhage may occur. The heart in these acute cases is congested particularly on the right side. The stomach

shows a condition of catarrh, the mucosa being covered with a thick yellowish mucus, hæmorrhages being visible in the submucosa. These changes may conceivably be due to the swallowing of saliva and exudate from the nose and expectorated fluid in which chlorine is dissolved. The venous congestion of the stomach and other abdominal organs and of the brain is due to the asphyxial character of the death.

Experiments made on animals make quite clear the stages of toxic effect. Using bromine in concentration of 1 in 1,000 approximately, we find that the mucous membrane of the windpipe, killed by the poison, may be stripped off by the violence of the respiratory efforts, so that, drawn down into the large bronchi, it forms a tree-like cast therein, suffocating the animal. Chlorine, in our experience, causes a greater exudation of fluid than bromine. Chlorine (1 in 1,000) breathed through a tracheal cannula may shortly cause in a cat such an exudation of fluid that it fills up the trachea. By compressing the chest many cubic centimetres of the fluid can be squeezed out of the lungs into a basin. It is a clear serous liquid containing plenty of coagulable protein. That this fluid drowns the animal may be seen by the relief which is given after squeezing it out.

Professor Schäfer, experimenting with very high concentrations of chlorine gas (e.g., one to two per cent), has concluded that death is brought about by stasis in the pulmonary vessels. If this is so for the high concentrations used by Sir Edward, it is not so in the case of the weaker concentrations such as are breathed on the battlefield.

We have put the matter to the test in two ways: (1) We manipulate the animal so that we can artificially respirate one lung with pure air, the other with air containing chlorine. Recording the blood-pressure, we first of all proved that artificial respiration of either lung suffices to maintain the circulation in undiminished vigour. We then gave air plus chlorine to the one lung, and observed the gradual production of congestion, œdema, and lessened expansion of that lung, leading to symptoms of asphyxia and failure of the circulation. On respirating the other lung with pure air, we observed the complete and immediate recovery of the circulation. On now squeezing fluid out of the first lung and respirating that, we saw that the circulation may continue, the asphyxia no longer being complete.

In the other set of experiments we had the co-operation of Dr. Kuno, of the Physiological Institute, University College, one skilled in the particular technique required. The circulation was confined by Dr. Kuno to the heart and lung preparation, and the technical arrangements made so that the output of the heart could be measured at any period of the experiment.

The thorax was widely open and the lungs exposed to view. On giving chlorine the first and immediate effect was a very evident

diminished expansion, due, we thought, to contraction of the bronchial tubes. Congestion and œdema followed, appearing first in patches on the surface and then spreading; as these grew marked, the blood became more and more venous; the output, it is true, was then diminished, but whatever stasis there was in the pulmonary vessels did not markedly affect it.

It is well known that a very large part of the pulmonary vessels can be ligatured, and yet an adequate circulation be maintained through the remainder. A very small portion of lung suffices, too, to keep up the oxygen supply to the heart.

These experiments made clear to us how artificial respiration keeps alive the gas-poisoned animal. If fluid be forcibly squeezed out of the lungs of a chlorined cat struggling for breath, its condition is greatly improved. If air is forced by artificial respiration into the lungs emphysema in places may be produced, but the heart is kept going.

Symptoms and Lesions of the Lungs in Experimental Animals.

Animals exposed to chlorine exhibit first of all profuse watering of the eyes and salivation; they make efforts to escape, and if the chlorine in the chamber is not mixed by a fan but sinks to the lower parts, they hold up their heads as high as possible to escape breathing the more concentrated lower stratum. The respiration soon becomes quickened and then, as the œdema of the lungs and exudation into the air-tubes increases, the respiration becomes slower and laboured. The obstruction to the entry of air becomes great, and in consequence the lower ribs are drawn in with each inspiratory gasp. The mouth gapes open and a frothy secretion hangs round the orifices of nose and mouth. The whole effort of the animal is given up to breathing; finally it falls over exhausted, the breathing becomes rarer and shallower and it dies. If in the stage of laboured breathing the animal be removed from the poison, it generally dies during the next twenty-four hours, but may live longer, to die within the next few days. One of our animals died as late as a fortnight after the exposure.

Examination of the lungs of these which die in the first twenty-four hours shows an intense congestion of the lungs; they are dark red in colour, a more or less solid œdema prevents their collapse on opening the thorax. The air-tubes contain frothy exudation which, on cutting the lungs, exudes in large quantities. When the lung of a rat was kept in a covered dish it shrank like a blood-clot, exuding serous fluid till it floated in it.

The animals which die in the later days show more or less extensive patches of red hepatization. Those parts of the lungs which were least poisoned appear relatively normal, but are more rosy in colour. Microscopic examination was carried out on the animals poisoned by us by

Professor William Bulloch. The sections show intense congestion and small hæmorrhages in places, and an œdema which fills the hardened alveoli with an eosin-stained homogeneous coagulum, reminding one of the appearance of the thyroid alveoli filled with colloidal secretion. The coats of the arteries are enormously distended with exudate, giving a most remarkable picture. The epithelium of the air-tubes is in many places detached. The animals die in the early stages from asphyxia, and in the later stages from pneumonia, with consequent absorption of toxins and exhaustion.

In those animals which are less severely poisoned the laboured breathing gradually passes away; those that recover appear quite normal at the end of a fortnight. Their fur, which was made sticky and looked, so to speak, burnt at the ends, becomes glossy again, the damaged hairs being shed. These animals, if killed during the process of recovery, generally show small pneumonic patches. The lungs seem very sensitive to further injury during the period of recovery; inhalation of chloroform may cause in them an acute œdema, and drown the animal.

There seems no reason why recovery of the lungs should be any less perfect after chlorine poisoning than it is after broncho-pneumonia. The damaged and shed epithelium of the air-tubes can be replaced, and the pneumonic patches resolved by the absorptive action of the phagocytes, until repair is complete.

I have no evidence to offer as to the state of the lungs at any long period after the poisoning.

The remarkable fact that some parts of the lungs are far more severely damaged than others requires an explanation. When chlorine of, say, 1 in 1,000 is driven into the lungs by artificial respiration, and the lungs are exposed and observed from the start, it is evident that the poison reaches and severely damages certain parts on the surface while other points remain normal. In these experiments the current of air from the pump was driven through chlorine water and then passed into the wind-pipe. We must suppose either that the chlorine does not uniformly mix with the air, or that certain air-tubes are shut up by contraction of the bronchial muscles and so prevent the poison reaching the alveoli they supply.

There is no doubt that the first effect of a concentration such as 1 in 1,000 is to cause contraction of the bronchial muscles and diminish the expansion of the lungs. Using enormously strong concentrations, Sir Edward Schäfer finds no evidence of such contraction—probably the concentrations he used rapidly killed the lining membrane of the air-tubes, including the muscle. Some experiments conducted by F. J. Twort and myself on the oxygenation of the blood, in subjects breathing in a shallow way, suggested to us that parts of the lungs may then not be expanded nor the blood oxygenated in these parts, and that the bronchial muscles may regulate to which part of the lungs the air goes on each

inspiration. The results of our chlorine experiments seem to confirm this view.

Treatment.—For the severe cases of chlorine poisoning the object of treatment must be that of getting rid of the exudation in the air-tubes which is drowning the victims. Experiments on animals show that the frothy fluid can be easily squeezed out of the lungs and trachea by rhythmic compression of the thorax, and that the dyspnœa which is threatening life can be greatly, if only temporarily, eased by this means. Artificial respiration is reported to have given good results on several of the cases on which it was tried. The artificial respiration requires to be repeated as often as the dyspnœa becomes excessive. The case is recorded of one man, almost moribund, who was treated in this way on four successive occasions, and who ultimately recovered. After squeezing out the fluid, air may be blown into the lungs by mouth-to-mouth artificial respiration, to overcome the resistance of the froth in the smaller tubes and expand enough lung to keep the patient alive. It is true that emphysema may be caused by so doing, but if it is a question of just carrying a man through the threatened asphyxia, one cannot hesitate to get air into the lungs by these means.

I took over to Flanders an apparatus constructed by Messrs. Siebe, Gorman, called the Vivator, in which there is a foot-pump which feeds a face mask through a flexible tube. By each downstroke a measured volume of air, or oxygen, is pumped into the lungs, by each upstroke a valve is opened which allows the air to escape from the lungs by the elastic recoil of the thorax and lungs. With this apparatus respiration can be kept going in the collapsed or unconscious cases, the fluid now and again being evacuated by squeezing the thorax and by posture.

The inverted posture will help to drain out the fluid. I was told that several of the patients of themselves hung their heads down over the side of the stretcher, or table, in order to aid their expectoration.

Emetics have proved very useful in giving relief to the less critical cases. Half a pint of salt and water, or eight grains of copper sulphate, followed by large draughts of lukewarm water, are recommended. A brush, or the patient's finger, put to the back of the throat will initiate the vomiting without delay. The act of vomiting is reported to cause the expulsion of a large quantity of the frothy fluid.

Administration of oxygen relieves the cyanosis and improves the condition of the subjects.

Not only does the percentage of carbonic acid in the blood rise in the suffocative condition, but other acids, such as lactic acid, increase in quantity owing to the lack of oxygen. When the blood is oxygenated by breathing of oxygen, these other acids do not appear, and the acid intoxication is therefore so far eliminated. Tests of the power to hold the breath show that a higher percentage of carbon dioxide can be borne when oxygen rather than air fills the lungs. To give oxygen to a man

who is struggling for breath and needing to expectorate is no easy matter. It is difficult to get tolerated any kind of close-fitting face mask. The ordinary clinical method of administering oxygen through an open funnel held near the mouth and nose, is of relatively small value; nearly all the oxygen is wasted by escaping into the atmosphere; just at the period of inspiration the stream is not enough which reaches the mouth and nose, so that the air drawn into the lungs is but very slightly enriched. I have found the oxygen in my alveolar air increased by only one or two per cent when oxygen was administered to me by a sister in a London hospital. If a loose kind of face mask be made out of a towel, and the oxygen tube be led under that, and the oxygen sent in sufficient stream to blow away the exhaled carbon dioxide, then seventy per cent of oxygen can easily be obtained in the alveolar air. Down Bros. have made a transparent face mask on my design fitted with a curtain which drapes the face, by which oxygen can be effectively given on this plan—but not economically. A twenty-feet cylinder is soon blown away by these methods. To give oxygen economically, a well-fitting face mask, breathing bag and cartridge for absorbing the exhaled carbon dioxide must be used. The subject breathes through the cartridge in and out of the breathing bag, which is filled with oxygen from the cylinder as required. The cartridge is loosely packed with small pieces of caustic soda-coke; to prepare these the coke pieces are heated red hot and dipped into strong caustic soda. They offer a splendid absorbing surface and no appreciable resistance to the breathing.

This apparatus is made by Messrs. Siebe, Gorman. I took over some for use in Flanders. The difficulty in using such lies in keeping the mask over the face of a man who wants to struggle and expectorate. Oxygen breathed between the periods of expectoration will undoubtedly give him relief, and with the above apparatus a twenty-feet cylinder will give a supply lasting many hours.

Experiments on animals have showed us that compressed air relieved the dyspnœa to the same extent as oxygen does. On placing a patient in a medical air-lock, such as is used in compressed air tunnel works, and compressing him to two atmospheres, he would breathe double the concentration of oxygen, and at the same time would be able to expectorate and struggle as he pleased. The compression of the air when first applied would halve the size of the air bubbles in the frothy liquid which obstructs the air-tubes, and this should give relief by lessening obstruction. Artificial respiration could be applied in the compressed air chamber, and the subject be kept in it for several hours, and then slowly decompressed. The medical locks are fitted with air-locks, through which the medical officer can enter or leave. The difficulty, of course, lies in the provision of such medical locks, heavy cylindrical boiler-like structures, each of which would hold only four or five patients, with the necessary oil-driven compressor engine. A small medical lock and engine would

go on a three-ton lorry, but it is a serious thing to hamper the transport of the Army with such a provision. There is another way in which oxygen might be administered without the use of a mask, and that is by drawing over the stretcher containing the patient a cylindrical balloon, say ten feet by four feet, tying up the end, and then distending the balloon with oxygen.

The giving of atropine has been extolled on the theory that it lessens secretion of fluid and dilates the bronchial tubes. In severe cases of poisoning we have not found it of the least service.

It is claimed that the inhalation of stramonium vapour from cigarettes relaxes the bronchial muscles; this may afford relief in the mild cases, which recover whether so treated or not.

The chlorine poisoning of the lungs is comparable with extensive burns of the skin, and the same general treatment to support strength and lessen the shock is required. Just as septic infection of the skin is the sequel of the burn, so pneumonia and bronchitis follow chlorine poisoning. In our experimental animals, severe poisoning has in every case had this end, and we know of no means of preventing it. Warmth and good nursing might pull a man through; these conditions are difficult to apply to animals.

Reviews.

WOUNDS OF THE THORAX IN WAR. By J. Keogh Murphy, M.C.Cantab., F.R.C.S. London: Henry Frowde, Hodder and Stoughton, 1915. Pp. 156. Price 2s. 6d. net.

This, another of the War primers published by the Oxford University Press, is well up to their good standard.

In his preface Mr. Murphy aptly says: "I have therefore endeavoured to make this handbook the result of my own personal experience, as well as of those with whom I have been brought into personal contact; and I must leave the statistics of these inquiries to be dealt with in full by others, when the time has come to collate from many different sources the general results of injuries in the Great War, and these will, no doubt, show wide differences in different theatres." The book is well planned, the first chapter being devoted to projectiles, a feature we commend. The body of the book is devoted to wounds of the chest and their complications, sequelæ and treatment, and there is an excellent last chapter on bacteriological therapeutic measures.

The chapter on hæmothorax is an excellent one, and should be carefully read. The author is strongly opposed to the use of the exploring or aspirating syringe in all cases, whether severe or moderate. His views and reasons are clearly put. He states: "In dealing with a hæmothorax the plunging of a syringe into the chest can hardly be considered an entirely safe procedure nor even a sure test for diagnosis."

His views on the fallacy of washing out the cavity of an empyema

are equally sound; but it is not altogether a wise proceeding in operating on an empyema to turn the patient on the sound side. It is wiser to have the affected side well over the edge of the table and operate by removing ribs in the mid-axillary line.

The immediate treatment of wounds by the methods of Sir Watson Cheyne, and of Cheatle, Fildes and Rajchman, are included in detail and should be carefully read, as well as the notes on the use of iodex. This volume can be thoroughly recommended as an excellent practical handbook to all engaged in war surgery.

OLD LONDON'S SPAS, BATHS, AND WELLS. By Septimus Sunderland, M.D. London: John Bale, Sons and Danielsson, Ltd., 1915. 36 illustrations. Pp. xii + 169. Price 7s. 6d. net.

Taking into consideration the physical features of the site on which London (which here includes outlying villages now included in this area) and its geographical formation, it would be strange if there were not numerous springs and wells, and still stranger, in a credulous world, if to many of them ecclesiastical or medicinal virtues were not attributed.

Dr. Sunderland presents a very interesting account of the various ways in which these natural features were developed, a mode of evolution, in many cases irrespective of the real properties of the waters, which is not unknown even in these scientific days. There is much miscellaneous information, archæological, historical, ecclesiological and general, scattered throughout the volume, to which full consideration can only be given by an expert in these matters.

It can be recommended to anyone interested in old London, especially to one who has time to follow Dr. Sunderland in his peregrinations.

Current Literature.

Observations on Antityphoid Vaccination (by Henry J. Nichols, M.D., Captain, Medical Corps, U.S. Army).—In this paper some evidence, experimental or clinical, is presented on the following subjects:—

(1) The infectious power of a living sensitized vaccine.

(2) The absence of immunity in vaccinated rabbits to direct gall-bladder infections.

(3) The relative pathogenicity, virulence and toxicity of the strain "Rawlings" used in the Army vaccine.

(4) Local vaccine reactions after typhoid fever and after immunization.

THE INFECTIOUS POWER OF A LIVING SENSITIZED VACCINE.

The author has already shown in a previous paper that Besredka's sensitized vaccine may produce a gall-bladder lesion in the rabbit after intravenous injection, and from this it was inferred that this vaccine would produce the disease in man if accidentally taken by the mouth.

Its general use, especially in military service, was therefore concluded to be dangerous. Further work was therefore performed.

On October 28, three rabbits were injected directly into the gall-bladder with one cubic centimetre of Besredka's vaccine. The vaccine was

then more than one year old, but still gave a growth of typhoid bacilli in pure culture. On November 10, the stools of the three animals were examined and typhoid bacilli were easily recovered from each of the three animals. On autopsy a purulent cholecystitis was found and pure cultures of the typhoid bacillus were cultivated from the pus in all three animals.

This experiment confirms the former one. Complement is necessary to destroy the bacilli in the vaccine; this is present in the blood-stream but not in the alimentary canal. Any food or water contaminated with this vaccine would be apt to spread the disease among non-immunes. From this point of view this vaccine is simply a pure culture of pathogenic typhoid bacilli and should be treated as such. The toxicity of a sensitized vaccine is considerably less than that of an unsensitized one, but its infectious power is unimpaired except when complement is present. Immunized rabbits can be infected by direct inoculation into the gall-bladder.

The Relative Pathogenicity, Virulence and Toxicity of the Army (Rawlings's) Strain.

The most convincing clinical evidence of the protective value of anti-typhoid immunization has been furnished by the recent experiences of the British and American armies.

The same single strain has been used in the preparation of the vaccine in both services, and substantial protection has been secured in spite of exposure to typhoid in all parts of the world. The American military statistics show no lowering of the previous remarkable records, but failure in immunization has been reported in civil communities, the vaccine used being prepared from other strains.

Pathogenicity.—This strain is still pathogenic as may be seen in the following experiments:—

On October 8, three rabbits were inoculated directly into the gall-bladder with one-twentieth of a fresh agar slant growth; a month later autopsy showed a definite cholecystitis with pure cultures of the typhoid bacillus in two out of three animals.

Virulence.—The fact that in the above experiment one rabbit escaped shows a lowering of virulence. This is confirmed by the following experiment:—

Six animals were inoculated intravenously with one-half the fatal dose of living bacilli, and after one month no gall-bladder lesions were found in any of them. The virulence of the Army strain was also tested by means of intraperitoneal injections into guinea-pigs.

It was found that this strain failed to kill after injection of a whole agar culture whereas other strains were fatal in doses of as low as one-seventh of an agar slope. The fatal dose of the Army strain in one series was two and a half agar slants.

Toxicity, as distinguished from virulence, is tested by the toxic effect of the injection of killed cultures. There is little or no relation between virulence and toxicity, as it was found that although the Army strain showed little or no virulence it was just as toxic as the more virulent strains.

This subject is of clinical importance as local and general reactions

are equally sound; but it is not altogether a wise proceeding in operating on an empyema to turn the patient on the sound side. It is wiser to have the affected side well over the edge of the table and operate by removing ribs in the mid-axillary line.

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On October 28, three rabbits were injected directly into the gall-bladder with one cubic centimetre of Besredka's vaccine. The vaccine was

then more than one year old, but still gave a growth of typhoid bacilli in pure culture. On November 10, the stools of the three animals were examined and typhoid bacilli were easily recovered from each of the three animals. On autopsy a purulent cholecystitis was found and pure cultures of the typhoid bacillus were cultivated from the pus in all three animals.

This experiment confirms the former one. Complement is necessary to destroy the bacilli in the vaccine; this is present in the blood-stream but not in the alimentary canal. Any food or water contaminated with this vaccine would be apt to spread the disease among non-immunes. From this point of view this vaccine is simply a pure culture of pathogenic typhoid bacilli and should be treated as such. The toxicity of a sensitized vaccine is considerably less than that of an unsensitized one, but its infectious power is unimpaired except when complement is present. Immunized rabbits can be infected by direct inoculation into the gall-bladder.

The Relative Pathogenicity, Virulence and Toxicity of the Army (Rawlings's) Strain.

The most convincing clinical evidence of the protective value of antityphoid immunization has been furnished by the recent experiences of the British and American armies.

The same single strain has been used in the preparation of the vaccine in both services, and substantial protection has been secured in spite of exposure to typhoid in all parts of the world. The American military statistics show no lowering of the previous remarkable records, but failure in immunization has been reported in civil communities, the vaccine used being prepared from other strains.

Pathogenicity.—This strain is still pathogenic as may be seen in the following experiments:—

On October 8, three rabbits were inoculated directly into the gall-bladder with one-twentieth of a fresh agar slant growth; a month later autopsy showed a definite cholecystitis with pure cultures of the typhoid bacillus in two out of three animals.

Virulence.—The fact that in the above experiment one rabbit escaped shows a lowering of virulence. This is confirmed by the following experiment:—

Six animals were inoculated intravenously with one-half the fatal dose of living bacilli, and after one month no gall-bladder lesions were found in any of them. The virulence of the Army strain was also tested by means of intraperitoneal injections into guinea-pigs.

It was found that this strain failed to kill after injection of a whole agar culture whereas other strains were fatal in doses of as low as one-seventh of an agar slope. The fatal dose of the Army strain in one series was two and a half agar slants.

Toxicity, as distinguished from virulence, is tested by the toxic effect of the injection of killed cultures. There is little or no relation between virulence and toxicity, as it was found that although the Army strain showed little or no virulence it was just as toxic as the more virulent strains.

This subject is of clinical importance as local and general reactions

seem to depend directly on toxicity rather than on virulence. Experiments were made on rabbits by injection intravenously of killed cultures; the result of these experiments showed that the vaccine is distinctly ioxic, especially during the first three months, after that time the toxicity is gradually on the wane.

As was said before, more virulent strains tested in the same way have not proved any more toxic. It was also shown by experiment that a vaccine killed by heating and addition of tricresol is less toxic than one which has been killed by trikresol alone.

The author holds that the net result conforms to the theory that the efficiency of the Army vaccine depends on its toxicity.

Pfeiffer and Bessau hold that the toxic and immunizing fractions are identical and that efforts to separate them are wrong in principle.

In the opinion of those who are most responsible for the introduction of this method of protection something must be paid for immunity in terms of local and general reaction.

Summary.

(1) Metchnikoff and Besredka's living sensitized vaccine produces a typhoid cholecystitis when injected directly into the gall-bladder of rabbits. It is therefore infectious.

(2) The strain used in the Army vaccine is pathogenic, relatively avirulent, and distinctly toxic. Its efficacy is believed to depend on its toxicity.

(3) Vaccinations in those who have had typhoid and revaccinations produce in some instances more severe local reactions than original vaccinations.

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THE BRADSHAW LECTURE ON WOUNDS IN WAR.

BY SURGEON-GENERAL SIR ANTHONY BOWLBY, K.C.M.G.

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IT is a striking testimony to the advances made in our knowledge of the healing of wounds that one of the most important points for present consideration in connection with the wounds of war is the geographical situation of the battlefield. In all old treatises on gunshot wounds we find that the authors devoted their attention mainly to the nature of the projectile and its direct effects on the tissues of the body, but, important as are still these considerations at the present day, they must now be studied in conjunction with the terrain of the war.

It is for this reason that I would preface what I have to say to you to-day with the statement that my own experiences are limited to two wars, the one in South Africa in 1899-1900, and the other the present war in Northern France and Belgium. And so widely different have I found the conditions of the wounds in these two campaigns that I realize it would be unwise to speak too dogmatically of wounds in those many other fields of the war now being waged in different parts of the world. I propose, therefore, to speak to you only of the wounds I have seen during the past fifteen months, for it was in September, 1914, that I went to France, at a time when the battle of the Aisne was in progress. From that time until the second week in October I was chiefly

occupied at the hospitals at Rouen, although I also visited Paris and its neighbourhood.

Early in October, however, I was directed to join the General Headquarters in the North of France, and ever since that time I have visited daily the various casualty clearing stations at the Front, and have also seen from time to time the work done in the field ambulances. My experiences, therefore, are, on the whole, concerned with recently wounded men, but many of these latter have been kept under observation for several weeks, either in the clearing station, or in the large stationary hospital at General Headquarters, where Mr. W. S. Dickie is in chief surgical charge.

In the first place, I wish to point out how radically different are the fields of war in South Africa and in France. In the former we had to fight in a very thinly inhabited country which supported very few domestic animals, and which, for the most part, was quite uncultivated. The soil was dry and sandy, and in many places the rocks projected in the form of the well-remembered "kopjes." The ground was uncontaminated by manure, and was to a great extent "virgin soil." Rainfall was slight, cloudy days very few, and a hot sun with fresh breezes or strong winds desiccated the soil and prevented the growth of any luxuriant vegetation. The consequence of all these conditions was that, in the absence of decaying vegetable and animal matter, the soil was almost entirely free from all pyogenic organisms, and bacteriological examination proved that all forms of pathogenic bacteria were absent from the soil of the veld, except in the neighbourhood of the dwellings of man.

At the present seat of war we find all these conditions reversed. The country is thickly populated with human beings, and supports many cattle and pigs; the soil is a rich loam, and rocks nowhere project through it; it is more heavily manured with the excrements of men and animals than almost any other land, and is covered by luxuriant crops. Rainfall is copious, cloudy days are numerous, and in many months sunshine is almost absent for long periods. One result of these conditions is that every form of micro-organism flourishes, and even in soil taken from a considerable depth below the surface the spore-bearing pathogenic organisms abound.

The behaviour of the wounds in the two wars have an unfortunately grave difference, which corresponds to some extent with the conditions I have just enumerated. But, in addition to the differences in the soil and surroundings, the wounds of the South African War also differed in almost every way from the injuries

of the present campaign. The "ogival" bullet of that day produced much less smashing and rending than does the pointed bullet now in use, and, while in this war the majority of the wounds are inflicted at close range by a missile travelling at the height of its velocity, in South Africa they were more often due to bullets fired at a distance of half a mile or more, and which, travelling at a much lower speed, had infinitely less power for harm.

In addition to this, shell wounds amongst the British troops were extremely rare in the African campaign, while in this war they are perhaps quite as numerous as those caused by bullets. In general terms it may be said that the injuries seen in the Boer War were infinitely less severe, and the complications due to them far fewer and less serious, than those of the past year in France, so that it very soon was evident that we had to unlearn most of our South African experiences. I will give but one example to illustrate this. In January, 1900, two Australian troopers were sent into the Portland Hospital in South Africa, in each of whom the femur was fractured and comminuted in its upper third by a bullet wound. The injuries were three days old, and the only treatment had been the application of a small first-field dressing and the bandaging of the limb to a rifle with puttees thick with dust. The blood-stained breeches had not been removed, and the first dressing and the puttees had not been changed. Yet the men were in excellent condition, and their wounds never gave the slightest trouble. But similar injuries, with similar treatment, in the present war would almost certainly have resulted in the death of the patients from gangrene, or at least in a prolonged suppuration and probable loss of the limb; and many surgeons who are familiar only with South African conditions seem unable to realize the completely altered picture of the present war.

I am very well aware of the difficulty of explaining with sufficient clearness the conditions under which our men in France are wounded and treated, nevertheless, before I attempt to describe the general nature and treatment of their wounds, I will endeavour to put before you the circumstances in which these wounds are received.

You are all well aware that ever since the battle of the Marne the opposing armies have lived and fought in trenches, but it must be remembered also that in both of the battles of Ypres, as well as at Neuve Chapelle and Loos, and on many other occasions, there has been a great deal of fighting in the open as well. Still, the fact remains that, owing to their partially subterranean life, men

are usually covered thickly with either mud or dust at the time when they are wounded, and that their comrades who help them are in a similar condition. When a man in one of the advanced trenches is hit and falls, he lies in mud or dust, or else, as during last winter, in muddy water a foot or more in depth. Close at hand, or else perhaps some hundred yards distant, the regimental medical officer has prepared a larger and deeper excavation commonly known as a "dug-out," and to this the wounded man will walk if he is able. If unable to walk he must be carried, but he cannot be carried on the usual stretcher, because it is too long to pass along the narrow trench, which is rendered tortuous by the many "traverses." Under these circumstances he may be carried sitting on sacking slung from a pole, if he is well enough to help himself, or else he may be taken on a "trench stretcher," which is much shorter than the usual stretcher and is a very simple and ingenious invention which has been of great service. His wound is not infrequently dressed by his muddy and dusty comrades if it is accessible to them, and in any case it is dressed in the dug-out if not before. From here the patient has now to be transferred to the first-aid post, which is established by a section of a field ambulance at some place which is as much sheltered from fire as may be, half a mile or more in the rear. Access to this is generally obtained by passing along a "communication trench," which may be six or eight feet deep, and more or less muddy or wet. The first-aid post is usually above ground, but may be in a "dug-out" or in a cellar. The patient is not detained here longer than absolutely necessary, but is transferred by a horse-drawn vehicle or on a wheeled stretcher to the main field ambulance, a mile or two further back. Here are either tents or buildings which have been adapted for use, and here fresh dressings and food and much-needed rest on stretchers are all provided. The wounded man is now in comparative safety, and if his injury is slight and there is no crowd of wounded, he may remain here for some hours. If, however, his wound is serious or dangerous, or if a battle is in progress, he is taken in a motor ambulance to the "casualty clearing station," a very few miles further back, and usually placed so as to be just out of the range of ordinary shell-fire.

These clearing stations were the invention of a date subsequent to the Boer War, and were for the first time put to a practical trial in the present war. Their personnel and equipment were provided for the treatment of two hundred wounded, and they were originally

intended merely to enable the field ambulances to "clear" themselves and then to pass the wounded on to the stationary hospitals or to the base. The circumstances of this war, however, soon showed that they could be made infinitely more useful than this, and before the end of the year 1914 they had been transformed into well-equipped hospitals capable of dealing with all urgent operations and of retaining and nursing those patients whom it was not advisable to send on by rail. It is into such hospitals as these that the wounded come from the field ambulances, and at which they often arrive within a very few hours of being injured.

It must next be realized that in the early days of trench warfare the long "communication trenches" of the present day did not exist, for they may take months to complete, and, as a consequence, men had usually to be retained in the advanced or support trenches till night afforded some protection from the enemy's fire, and in this way much delay necessarily ensued in getting the patient out of his muddy surroundings and to a place where he could be adequately treated. There are some trenches in which similar conditions still prevail.

On many other occasions, after a fight in the open, badly wounded men have been left lying between the opposing trenches, because any attempt to rescue them at once drew the fire of the enemy, and might easily have resulted in the death of the patient as well as of his would-be rescuers. In such circumstances, after nightfall, men will crawl in even with badly smashed limbs, and in other cases they are brought in by stretcher-bearers at very great risk. Others of them, however, cannot be brought in, and, especially after an unsuccessful attempt to capture an enemy position, they sometimes lie out for even days and nights. No doubt many such have died, and in others who have been ultimately rescued the condition of the wounds has been very bad. It was, of course, the men who were the worst wounded who had the most difficulty in getting into our lines, for those who had badly fractured legs or thighs, or were shot through the head, the lungs, or the abdomen, were quite unable to save themselves, and had to wait till the enemy was driven back or till darkness allowed their comrades to try and help them, in spite of the light given by the frequent "star shells" and the subsequent fire from the German lines.

One man lay out in a coppice last January for ten days with only a little pond-water to drink, and lost both his feet from gangrene, but escaped with his life. Another man lay for eight

days in a German "dug-out" with a completely smashed leg and in constant expectation of being discovered and killed, yet he also survived after amputation of the leg.

It is now time to turn attention to the nature of the missiles which cause the wounds we are considering, and they are certainly more varied and numerous than in any previous war. It is not yet possible to say with any accuracy what proportion rifle bullet wounds bear to the whole, and it must be remembered that the "quick-firing" machine gun which has borne so prominent a part in the German armament fires the ordinary rifle bullet, as does also our own quick-firer. The rifle bullet of British, German and French alike differs from all the bullets of the Boer War period. The point of the older bullet was rounded and ogival, and the whole bullet was of the same diameter in nearly its whole length. The point of the present bullet is like that of a sharpened lead pencil, and the consequence is that the balance of the bullet is altered so that its posterior half, or base, is much the heavier, and its centre of gravity further back. The importance of this to the patient and the surgeon is that the bullet is very easily caused to turn completely over on its long axis and so to enter the body sideways or base first. This is all the more likely to occur because, in trench warfare, bullets often pass through the earth of the parapet or strike a sandbag, but it is also true that when the speed of one of these pointed bullets is much diminished towards the end of the flight, it will readily turn over within the body after entering with its point first.

The German and the British bullets are much alike. Each of them consists of a soft core of lead or other metal contained in a sheath or "mantle" of hardened steel, and, though the German bullet has a higher muzzle velocity, I do not think there is much difference in the effect it produces in the human body, and I have seen a considerable number of Germans who have been wounded by our bullets. As is well known, the impact of the mantle-coated bullet on a rock or stone may break the mantle and allow the core to extrude, so that when it strikes a resisting structure, such as a large bone, it spreads and breaks up and causes much more extensive damage to the tissues as a result. It is seldom in my experience that the bullet is broken up by mere impact on a bone, though no doubt this does occur.

The French bullet is made of a copper compound, and is solid and homogeneous throughout, so that it has neither core nor mantle. It is longer and heavier than either of the other bullets,

but, as I have not seen very many patients wounded by it, I do not propose to allude to it further beyond saying that I think there is very little difference in the effects it produces on the human body.

In addition to bullets, an immense number of other forms of missiles have been employed, so that wounds have presented the utmost variety. It is not possible or necessary to describe in detail all the forms of shell, but in order to understand the nature of wounds it must be realized that shells differ immensely in their structure and in the way in which they produce injury.

(1) Shrapnel shells of all kinds and sizes are characterized by the fact that they contain some two hundred and fifty to four hundred round bullets of lead, which is in some shells soft, but in others is hardened by various agents. These bullets vary in size in proportion to the size of the shell, but are never more than about half an inch in diameter. The shell is usually timed by a fuse to burst in the air over the object aimed at, and, the shell case being blown open by the explosion, the bullets are propelled in a cone-shaped stream whose velocity is dependent on the velocity of the shell, and is not due to the force of the explosion which bursts the shell. The violence of their impact is great in proportion as the shell is still travelling at high speed and is not too far from the ground when it bursts, and the direction of the blow is generally downwards. Wounds may also be caused by the metal case, which is a foot or more long and weighs several pounds at least, but such wounds do not differ from those caused by the solid variety of shell. The velocity of the bullets is never as great as the muzzle velocity of a rifle bullet, and, as they very quickly lose force and power of penetration, their effective range is not a long one.

(2) "High explosive" shells vary in weight from a few pounds to about a ton, and they consist of a thick iron case containing in a central cavity a violent explosive charge. The latter is, in the case of German shells, tri-nitro-toluene, and as much as two hundred pounds weight of the latter may be present. Such shells are usually burst on percussion by a detonator, which acts by the impact of the shell on the ground or on some other object. These shells do not contain bullets, and the injury they do is caused in chief part by the jagged fragments into which they are split by the explosion, and also to some extent by the impact of portions of buildings, such as stones or bricks, which are scattered with immense force by the violence of the explosion. The fragments of the shell are always very rough and ragged and of every variety of size and shape. For example,

the base of a seventeen-inch shell may weigh one hundred and fifty pounds, and if it struck the body of a man would completely destroy it. Other fragments may weigh a few pounds and may tear off a limb or crush it to pulp, while in the smaller shells there may be scores of fragments about the size of the end of a finger or much smaller.

It must also be kept in mind that the mere explosive force of the gases of a large shell exercises great powers of destruction. The expansion of the gases is alone sufficient to kill, and in the only case in my experience in which an autopsy has been made the brain was the seat of very numerous petechial hæmorrhages.

(3) Bombs, hand grenades, rifle grenades, trench mortars, etc., are all characterized by a shell case of iron or other metal containing a relatively large charge of a high explosive. In the German projectiles this is always tri-nitro-toluene. The bomb case varies immensely. In some it is composed of iron about half an inch thick, which is often partially cut up into segments about half an inch square. In others it is composed of quite thin steel. When a bomb or grenade bursts, the case is commonly broken up into very numerous fragments of every size, from a pin's head to a lump of metal weighing several ounces. Some of these may be quite pointed and with an edge like a knife; others are often quadrilateral. Some of the German bombs contain also irregular jagged pieces of loose metal, and others are loaded with rough iron boot-nails about half an inch long and pyramidal in shape. All forms of shell and bombs also scatter stones, earth or sand from the parapets, and these all become projectiles, and are specially liable to injure the face, neck and shoulders of men standing in the trenches.

Such, then, are the various projectiles by which the wounds of the present war are caused, and it will be readily appreciated that the wounds are as various as the projectiles themselves.

The so-called "normal" bullet wound, such as was common in the South African War, and was characterized by a tiny aperture, which might have been made by a gimlet or a trocar, is in this war quite rare, and even if the entry is of this nature, the exit is almost always ragged and large. In many of the cases bullets tear the soft tissues to rags and blow out the muscles and fascia through great rents in the skin, and, when no bone is struck, such injuries as these are always due to the discharge of the rifle at close quarters, and generally within fifty yards. When a large bone is struck the damage is yet greater, and the part looks as if it must have been

struck by a large fragment of shell. This is due to the fact that the bullet, travelling at the height of its velocity, not only smashes the bone but also imparts its momentum to the shattered fragments and drives them in every direction, so that the injury to the soft tissues is inflicted in great part by the fragments of bone themselves.

Wounds caused by shrapnel bullets are not as extensive as the worst of those caused by the pointed rifle bullet, for although the former may make a large hole of entry they do not exercise the same divulsive or explosive force as the latter; they are, however, often multiple, and on account of the fact that this form of shell bursts in the air, the bullets very often wound the skull and brain.

The wounds caused by high explosive shell fragments and by bombs and grenades are so infinitely various that it is not possible to describe a characteristic shell wound as a type. It may be noted, however, that, all shell fragments being rough and jagged, they tear away parts of the clothing and carry the latter into the extreme depths of wound. The large fragments tear away from the limbs or trunk huge masses of skin and muscle, so that the whole of the calf or the front of the thigh, or the gluteal or deltoid regions, may be destroyed, and the tissues from which these have been avulsed are themselves so crushed and lacerated that all the vessels are pulped, and extensive areas die. In the neighbouring tissues there is, of course, widespread contusion and extravasation of blood, and, as a result of these injuries, the exposed muscle often loses all its natural characteristic appearance and looks exactly like a mass of mud, for it becomes a homogeneous mass of dark brown or slate-coloured matter without any appearance of striation or vitality, and, as it is quite dead, it may be cut away without causing either bleeding or pain. The condition is one which I have never seen in even the worst machinery accidents in civil life. In other cases fragments of big shells may tear away the abdominal wall and expose the viscera, or may carry away portions of the face or neck, while the bones of the limbs may be fractured or the limb itself may be completely shot away.

Nothing is more striking than the immense amount of destruction wrought by even quite small pieces of a shell burst by a large charge of a high explosive, for the wound in the tissues may be ten times as large as the missile. Thus, I have seen a man in whom a piece of shell not so big as the end of the little finger tore a large wound in the liver and then rent completely away the whole of the hepatic flexure of the colon, while in the limbs I have seen wounds as large as a clenched fist caused by quite small fragments, which

evidently mainly owed their power of destruction to the extraordinary velocity with which they travelled, as well as to their jagged edges.

The various forms of bombs and grenades are specially liable to cause multiple wounds, for they generally wound by bursting close to the patient; they break up into very numerous fragments, some of which are large and heavy and some of which are quite minute. At very close quarters quite small, sharp-edged strips of metal may penetrate very deeply, and even be driven into the intestine or lungs through tiny apertures, while many other men who are hit at some little distance by similarly small pieces of these bombs suffer little violence, for, as the fragments quickly lose their great initial velocity, such wounds as these are often slight. It has thus happened, during the last months of the war, that a very large number of men have had small wounds from which they quickly recovered, although, on the other hand, it is often noticeable that many of these grenade and bomb wounds are on the face, and that one or both eyes are often blinded by small pointed fragments or by gravel or stones.

It will thus be seen that the wounds in this war are often quite unlike those of previous wars, because they have been caused by new and different missiles, and it is further to be noted that the proportion of wounds by rifle bullets compared with wounds caused by shells or bombs is certainly much less than in previous wars. It is well known that never before has such extensive use been made of artillery and bombs, nor have armies ever previously faced each other over fronts of hundreds of miles at a distance of a few yards. It is this proximity and shortness of range which has caused bullet wounds to be so severe, and it is by the same proximity that the injuries by bombs have been made possible and frequent.

The very various wounds I have thus briefly described are for the most part quite different from injuries met with in civil life, and all surgeons in past years who have had war experience have recognized that gunshot injuries form a class alone. It is, of course, true that a very large number of slight and superficial wounds, and some cases of fracture, present no striking features, but where missiles have penetrated the body at high velocity the differences between such injuries and those of civilian life are radical.

The essential nature of all accidents such as are caused by machinery in motion, by vehicles of all kinds, or by kicks or blows, is a crushing and mangling of the limbs or trunk by force applied

from without inwards, so that the parts involved are crushed by a comparatively slowly moving object. On the other hand, in all penetrating wounds by bullets of all kinds, and by shell fragments moving at immense speed, the main injury is done by a force of a divulsive or expanding nature, so that the tissues are torn asunder from within instead of being crushed slowly from without. It is this rending asunder which is the special characteristic of all typical "gunshot" wounds, and it has been shown that the injury caused by a bullet is largely due to the wave of compressed air which the bullet drives in front of it, and which expands within the tissues. In all wounds which completely traverse the tissues this divulsive or explosive force is present to a greater or lesser extent, and the effect produced is heightened by the resistance offered to the explosive power. The result is that the injury, instead of being limited to the tissues on each side of the bullet track—as it would be if the wound were not made by a bullet but by a trocar—is diffused in every direction, and radiates through all the surrounding structures. It is, of course, well known that in the case of the brain enclosed in the skull, or the liver enclosed in its capsule, explosive effects are typical, and this is attributed to the enclosure in a strong capsule of tissues which are largely composed of water. But it is not sufficiently appreciated that these same effects are produced in every other part of the body and limbs also, and are directly proportionate both to the speed of the whirling projectile and to the resistance offered it by the structures which it encounters. The truth of this may be demonstrated on any limb shattered by a bullet, or a fragment of a high velocity shell perforating it, for it will be found on examination that the missile has not only shattered the tissues in the line of its flight, but that the divulsive force has separated the fascia from the skin and split the muscles from each other along their intermuscular planes. The effect of the injury may, indeed, spread up and down a great part of the length of the limb, and vessels may be burst and extravasation of blood may be found far from the obvious track of the missile.

But, although the effects of a bullet or piece of high velocity shell are so evident and extensive, it will be found by microscopical examination that they are even more extensive than appears to the naked eye, for if muscles whose sheath is yet intact, which appear perfectly normal, and are at some distance from the wound, are so examined there will be found fractures of the muscle bundles, extravasation of blood, and necrotic changes in the surrounding fibres.

This microscopical evidence of widespread injury is found not only in the limbs but also in the viscera, so that the liver and the kidney may show extensive interstitial hæmorrhage and a very remarkable disintegration of the cell at a considerable distance from the site of the obvious injury. I am much indebted to Lieutenants Adrian Stokes and McNee for the following reports on various specimens they have examined, and on which, amongst others, the above statements are based.

Serjeant C. died about twelve hours after shrapnel wounds of the chest and the abdomen, and the right kidney presented a perforation in its lower pole. A piece of kidney was taken from what was apparently a healthy portion of the upper pole for microscopical examination. It was hardly recognizable as kidney. There was present only a fibrous stroma of the tissue, without any of the specific kidney cells and only one or two glomeruli were recognizable. The tubules had apparently desquamated all their lining epithelium, and in a few of the collecting tubules there was present some granular material, perhaps representing the destroyed cells. The whole section was full of small hæmorrhages, and in places there was a slight infiltration with polymorphs (*see* fig. 1).

Private, No. 2 C.C.S. Wound by bullet of *anterior margin of liver*. Wounded 2.30 p.m., October 6, 1915 ; died 8.20 p.m., October 7, 1915.

Condition of Liver.—The bullet had penetrated the organ close to the anterior margin, just internal to the line of the gall-bladder. The laceration extended for a depth of one and a half inches into the liver substance. On cutting the liver into two parts so as to include the line of the laceration, an irregular area was observed, different in colour from the other parts of the organ, and situated almost three inches from the tear. No direct track could be found leading from the site of the injury up to this yellowish area.

Microscopic sections from this yellowish zone showed the following appearances: "The cells of the lobules are in many places very well preserved, the only abnormal feature being the great vascular engorgement of all the capillaries. Scattered throughout the sections, however, are numerous hæmorrhages, some of them exceeding in size two liver lobules. Round the margins of the areas of hæmorrhage the liver cells are definitely necrotic, nuclear staining being lost, and the protoplasm granular and faintly staining. In most places the ring of necrosis is narrow, but in others a wider area is involved in the process. In some sections, areas of necrosis alone seem present, but these are evidently in relation to hæmor-

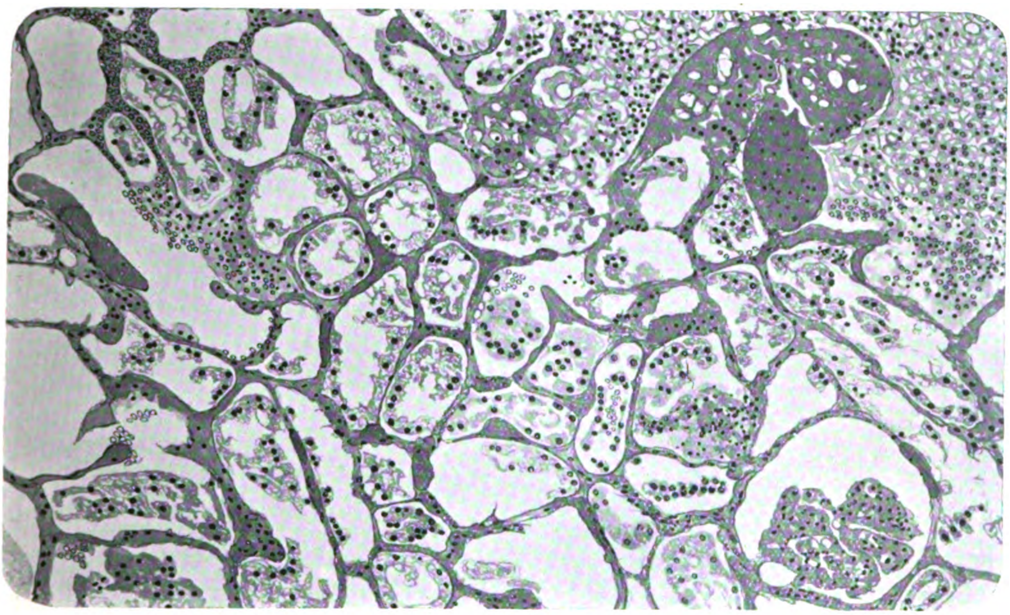

FIG. 1.

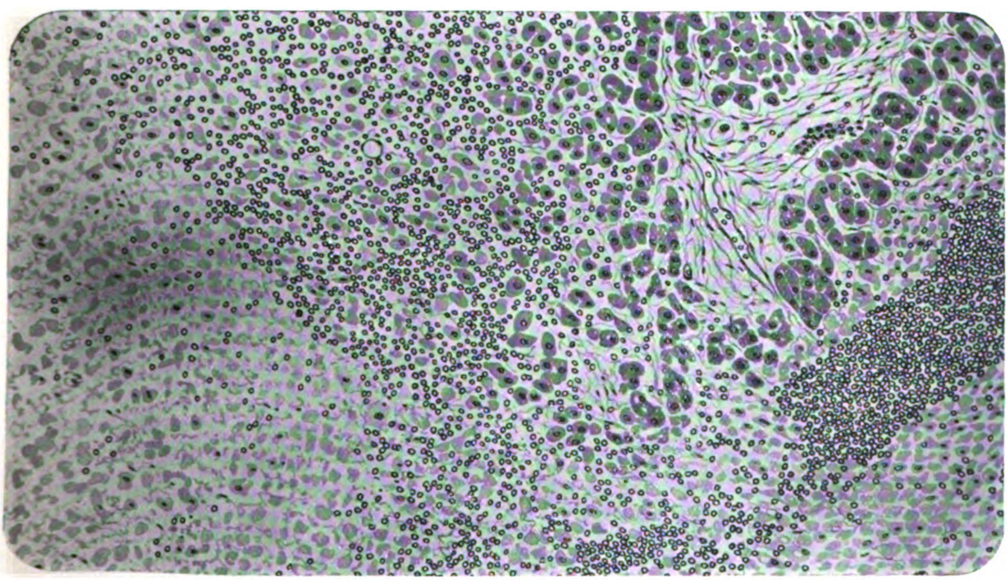

FIG. 2.

To illustrate "The Bradshaw Lecture on Wounds in War," by Surgeon-General Sir ANTHONY BOWLBY, K.C.M.G.

Reproduced from the "British Medical Journal."

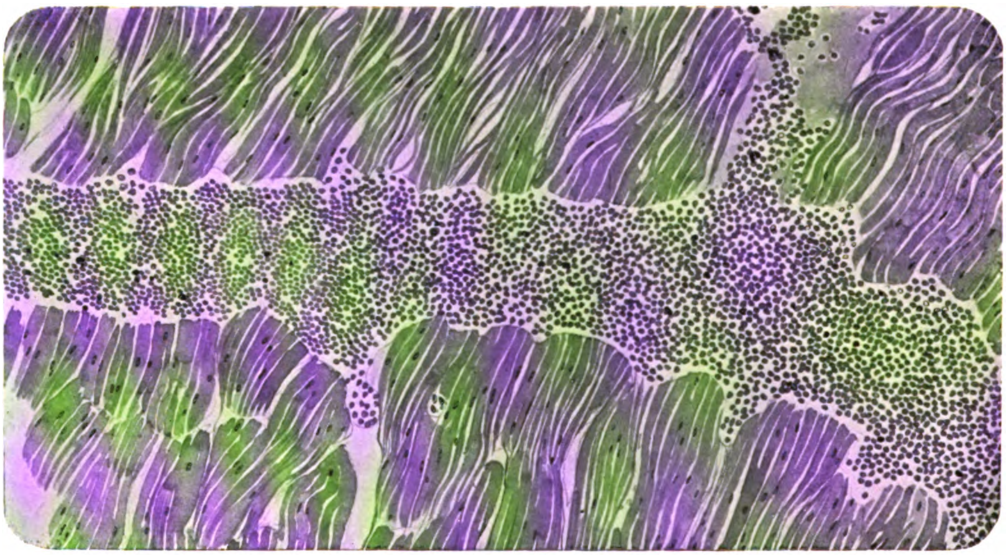

FIG. 3.

To illustrate "The Bradshaw Lecture on Wounds in War," by Surgeon-General Sir ANTHONY BOWLBY, K.C.M.G.

Reproduced from the "British Medical Journal."

rhages not included in the same section. No leucocytic infiltration or other evidence of sepsis is present anywhere" (*see* fig. 2).

Corporal, S— F—, wounded by shell 9 a.m. on October 11, 1915. Superficial injuries to foot, hand and scalp. *Three deep wounds on front of right upper arm, just below insertion of pectoral muscle.* Patient collapsed from hæmorrhage on admission. Amputation was performed at the shoulder-joint on October 13, and *tissue was taken* for examination *from the belly of the biceps* muscle, two inches below the lower margin of the wound at a place where the muscle appeared to be quite normal.

Condition of Muscle Examined.—The most interesting finding is the presence of a definite transverse rent, tearing across several bundles of muscle fibres, as seen in longitudinal section (*see* fig. 3). The ends of the muscle fibres torn across show necrosis, and the rent itself is filled up entirely by a mass of red cells and polymorphs, showing an intense inflammation to be present. Everything points to this small tear having occurred at the time of the original injury higher up the arm.

In other parts of the sections bundles of muscle fibres are widely separated, the interval between the bundles being filled entirely with polymorphs and red cells. One such bundle, separated from its neighbours on either side by a gap containing inflammatory cells, shows absence of all striation of the fibres, and is evidently approaching a condition of necrosis.

Private F., 6th D.C.L.I. Gunshot wound of left leg above the ankle, causing compound fracture of both bones. Wounded October 11, amputation twenty-four hours after the wound was received. *Muscle tissue taken* for examination *from the tibialis anticus*, several inches above the seat of the wound.

Condition of Muscle Examined.—The most striking feature in the sections is the wide separation of bundles of muscle cells from one another. A condition of very acute inflammation is present, all the spaces between the bundles being full of polymorphs. A distinct transverse tear is seen going half way across one bundle. The muscle fibres involved in the tear are quite without striation and obviously necrotic. The gap between the torn ends (*see* fig. 3) is filled in by polymorphs and red corpuscles, indicating, along with the necrosis of the muscle fibres, that the rupture occurred ante mortem and not during the preparation of the sections.

It is very easy to demonstrate the far-reaching effect of bullets when the bones are involved, and I will quote the two following cases as striking examples:—

In the first case a man was shot across the face and through the nasal cavities, the entrance wound being below the zygoma on one side and the exit through the zygoma on the other side. His symptoms were those of a man shot through the brain, and he died on the fourth day. The autopsy,[1] by Mr. Adrian Stokes, showed that, although the track of the bullet was an inch or more below the level of the base of the skull, yet the latter was fractured right across, and although the dura mater was unhurt, one frontal lobe and one temporo-sphenoidal lobe were more or less pulped.

In the second case a young officer was shot across the back of the neck and became completely hemiplegic, although the wound was apparently superficial. He died in two days, and an autopsy by Mr. Stokes showed that the bullet had only broken off the tip of the sixth cervical spine. The laminæ were not fractured and the dura mater was intact, yet the cord had been contused, and its grey matter was broken up by hæmorrhage. But it is possible also for the spinal cord to be injured by a bullet which does not even touch the vertebral column, and one patient died with hæmorrhage into the spinal cord in whom the bullet had merely passed through the muscles at the side of the neck and had caused no hurt to any of the vertebræ.

Other very striking examples may be cited where the intestines have been torn open by bullets without the peritoneal cavity being opened. In one case a bullet passed across the pelvis at the level of the trochanters, causing immediate collapse, from which the patient never rallied. He died in about ten hours, and at the autopsy it was found that the bullet had passed in front of the sacrum and had not entered the peritoneum. Yet, when the peritoneum was opened anteriorly, it was found that a coil of the ileum six inches from the cæcum had been completely torn across.

In a second case of the same kind a bullet entered the upper gluteal region and emerged in the inguinal region, cutting the spermatic cord but not opening the peritoneum. Nevertheless the patient died from rupture of the intestine.

It will thus be seen that whatever tissue is examined or whatever part of the body is involved, all the evidence goes to show that in gunshot wounds the passage of the missile results in injuries to tissues which appear to be quite remote from its track, and it must be concluded that the vibrations set up by the projectile in the fluids of the body result in very widespread disintegration of both the small blood-vessels and of the cells of the parenchyma

themselves. As will be seen on further consideration, these changes are of great interest in considering the resistance of the body to microbic infection.

The next matter which demands the most serious consideration is the condition of the wounded men themselves. This necessarily depends on other circumstances besides the nature and extent of the wound, for it is influenced by the time that elapses before assistance arrives, by the amount of blood lost, by exposure to cold and wet, by want of food and drink, and by exhaustion due to want of sleep; and it is seldom that even in the case of slight wounds none of these factors complicates the injury.

I think that the thing that would strike most forcibly any observant person who was brought into a room filled by large numbers of recently wounded men from a big fight would be the fact that nearly all of them were asleep, in spite of wounds which one might well suppose would effectually banish sleep. There they lie on their stretchers with muddy or wet clothes, with bandaged limbs or head, quite content with the transition from the turmoil of battle to the comparative peace of a crowded room, which in itself offers little comfort. Some of them ask for food, but with many this is a secondary consideration, for when a man is worn out by long periods of watchfulness and laborious work in the trenches, and when the intense excitement of fighting for life and killing other men in the midst of the crash of shells and the clatter of rifles and machine guns has passed, then there comes the reaction and exhaustion of a tired out man and an overwrought nervous system. It is only a few of these men who are excited and talkative, and still fewer who wish to talk of their recent experiences, and those who only see wounded men in the base hospitals have little idea of the silence of a crowded room in a clearing station when heavy fighting has been in progress for a day or more. But as the surgeons work their way from man to man it is only too evident that some of those who are asleep are also suffering from profound collapse, so that there are many in whom the hands and feet are cold, the lips pallid, and the pulse either very small and rapid or quite imperceptible at the wrist. The wound of such a patient may, for its own sake, demand prompt treatment, but all who have had experience know that there are hundreds of men whose best chance of life is to be kept warm and left absolutely quiet, and persuaded to take hot soup or cocoa, or perhaps alcohol before again going to sleep. It is at first surprising to find how many quite pulseless men will slowly pull

round if they are only given time and kept thoroughly warm, and there are no more striking cases of this than men with bad compound fractures of the lower extremity, or with multiple injuries. They are, indeed, often so nearly dead that it may be several hours before any attempt can be made to dress their wounds, and, even with every care, there are not a few who die. The common causes of this collapse I have enumerated above, but it is often true that various causes all combine to bring about the condition. It thus happens that when a man has had a bad smash of a limb by a bullet or shell, the shock caused by such an injury is alone sufficient to cause much collapse. Yet in many cases this is followed by the anxiety of prolonged exposure to further wounds, and often by hours of wet and cold spent in the open, with no food, and with an undressed wound which hourly becomes more painful. And after all this there is the unavoidable pain of moving him from the battlefield to the hospital.

It is also a very noticeable fact that in many of these cases the patients are quite unable, at first, to retain any food, and that, even if no food is taken, retching and vomiting are very common for many hours. This is a complication of shock of which I have had no similar experience in civil practice, but it is, unfortunately, not only common, but often serious in gunshot wounds, as men who are much in need of food are unable to retain it. In many of these cases of vomiting, and also in all cases of severe collapse, numerous lives have been saved by the subcutaneous or intravenous injection of normal saline solution to the extent of several pints, and enemas of hot water and brandy have been similarly useful. As far as drugs are concerned, nothing has been more helpful than pituitary extract. There are also very many men who have sustained multiple injuries from bombs or shells, and some of whom have had two or even three compound fractures, and no class of case suffers more from shock than this. In others of these cases of multiple injuries, the whole chest or back or the surface of both thighs or legs is covered with numerous wounds which are caused either by fragments of the bomb or else by gravel and stones from the parapets, and, although the wounds may be quite superficial, the patients are very frequently severely collapsed. I have been in the habit of comparing these cases of multiple surface wounds with those of extensive superficial burns, where there is also much shock, and I think the two classes have much in common, for not only do they suffer from shock, but the sepsis following a burn is more than paralleled by the severe infection

with anaerobes, due to the multiple infection carried in by the gravel and bomb fragments. As in the case of burns also, picric acid is at once an excellent analgesic and antiseptic.

Secondary Complications of Wounds.—The primary complications of hæmorrhage and collapse are accompanied or followed by the secondary complications of bacterial infection, and it is practically true that every gunshot wound of this war in France and Belgium is more or less infected at the moment of its infliction. I have already described the condition of the men and their clothing, and how mud and dirt pervade everything, and bacteriological investigations of the soil, of the clothing, and of the skin demonstrate the presence of the most dangerous pathogenic organisms in all three.

No more interesting work on this matter has been recorded than that done by Mr. Alexander Fleming (*vide Lancet*, September 18, 1915) in Colonel Sir Almroth Wright's laboratory, and his whole paper is well worth study. I will here only quote some of his conclusions, and, in the first place, the results of his examination of the clothing of wounded men. He says: "From this it will be seen that of the twelve samples of clothing examined *Bacillus aerogenes capsulatus* was found in ten, *B. tetani* in four, streptococcus in five and staphylococcus in two, besides other organisms." It is therefore evident that the patient and all his surroundings when he is wounded are grossly infected, and all missiles which pass through the contaminated skin as well as through the clothing are liable to carry bacteria into the depths of the wound. And it must also be kept in mind that, even when no large piece of clothing is found in the wound, in practically all cases of injuries by shells or shrapnel bullets, minute shreds of coat, shirt or jersey will be found by a careful search.

Mr. Fleming gives the following table showing the microbic infection of one hundred and twenty-seven patients at different stages.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Time after infection	Total number of cases	*B. aerogenes capsulatus*	*B. tetani*	Putrefactive bacilli		Streptococci	Coliform bacilli	Staphylococci	Wisp bacilli	Diphtheroid bacilli	Large(?) bacilli
				B. x.	B. y.						
Stage 1— 1 to 7 days	127	103	22	14	5	102	37	40	9	0	2
Stage 2— 8 to 20 days	56	19	5	4	1	51	18	16	17	4	4
Stage 3— Over 20 days	27	5	0	0	0	24	19	19	16	0	6

He adds: "The spore-bearing anaerobes . . . progressively diminish in relative frequency as the age of the wound increases. . . . In the early stages these spore-bearers are present in much greater numbers than anything else, whereas, later, ... their numbers are relatively few." He considers also that all the first eight of the group of organisms tabulated above are of fæcal origin, including the streptococcus, which is so common an infection.

The work of pathologists at the Front, namely, Major Rowland and Lieutenants Stokes and McNee, has also demonstrated the presence of anaerobic and other organisms in quite recent wounds, and the conclusions arrived at in the British Army are all supported by the surgeons in the armies of our Allies.

Such, then, are the main facts as to the nature of the infection of the wounded parts, and it is the result of this infection that is the all-important question which has so deeply interested, not only the medical profession, but also the public in general. I think it may truly be said that nothing has more impressed the public mind than the septic nature of many wounds and the prolonged sufferings caused thereby. It may also be said that this sepsis came as a surprise to most surgeons, and as a disappointment to those who had believed that in antiseptic surgery we had forged a weapon to combat all such conditions. Many, indeed, have not hesitated to blame the surgeons in France for the conditions of the wounds, while others have devised and advocated many new remedies to deal with the unexpected condition.

It becomes, therefore, a matter of much interest to try and analyse the different bearings of this septic infection and to suggest how it may best be combated.

In the first place we must realize that in the gas-forming anaerobes at least we have to deal with an infective agent which is to all intents a new experience, and not only are these bacteria found in almost every wound, but they also attack the tissues more rapidly and violently than any other organism. They are practically unknown in civil practice in Great Britain as a regular wound infection, for they are so rarely encountered that, prior to this war, most of the younger surgeons had never seen a case of gas gangrene. I will not here interpose a long description of this condition, but will merely state that these anaerobes cause an inflammation characterized by great swelling and a copious sanious discharge full of bubbles of gas. This may only result in a cellulitis, or may involve the whole of the tissues of a limb, and has a special tendency to extend in muscles. It may cause

discoloration and death of the skin alone, or else the whole limb may swell enormously and be rapidly converted into a gangrenous mass of putrefying material, emitting the odour of a newly manured field. The patient in the worst cases presents all the appearances associated with severe shock or collapse, is often very sick, rapidly becomes pulseless, his hands and feet become damp and cold, the tongue dry and furred, and death follows the onset of the disease within about forty-eight hours. There is often very severe pain in the early stages, and most of this is due to the extreme swelling and tension, but, as the tissues die, all sensation is lost, and the end is usually quite painless. In the vast majority of wounds, however, although the same anaerobes are present, they are comparatively powerless to do much harm; their action is localized to the wounded area, and they produce merely a local sepsis and inflammation. The question naturally arises why such very various results should ensue from the same infection, and it is a noteworthy pathological fact that the action of the gas-producing organisms is greatly assisted by the presence of staphylococci or other bacteria.

In considering the explanation of these phenomena we are at once struck by the fact that these anaerobes attack a recent wound with the most alarming rapidity, and they produce their characteristic local and constitutional effects more rapidly after being inoculated than do any other organisms. I have indeed seen well-marked infection, with the formation of gas, within five hours of the receipt of a wound, and I have seen a whole limb gangrenous and the patient dead from hæmic infection sixteen hours from the time he was injured. It is evident, therefore, that in such cases the organisms meet with no resistance from the tissues, and the question to decide is, why do not the tissues resist in some cases when in very many other wounds the anaerobes have evidently but little power for harm?

A good deal of light is thrown upon this matter by the behaviour of the anaerobes in question when a limb dies from injury to its main vessels. I have seen many cases of gangrene due to injury to the iliac, femoral, or popliteal vessels, and some of injury to the axillary artery, and in every case but one as soon as ever the limb has died from loss of its circulation it has at once been invaded by the gas-forming anaerobes; and, if it has not been removed, typical gas gangrene has extended and killed the patient. In other patients where wounds have been infected to only a slight degree before death, as soon as death has occurred typical gas gangrene

has so rapidly spread that within three or four hours the limb has become a putrefying mass.

The important facts to keep in mind, then, are: first, the extreme rapidity with which recent wounds become infected; and, second, the fact that these anaerobes develop most characteristically on dead or dying tissues. And, keeping these in mind, we can then appreciate why certain wounds are affected more than others; for, other things being equal, it may be briefly said that "The more severe and extensive the injury, and the more the tissues are lacerated and devitalized, the more is the wound likely to be badly infected."

I have already described how the tissues are pulped by bad shell smashes and by bullet wounds with explosive effects, and I have mentioned that the muscles which have been crushed out of all resemblance to muscle may be cut away without causing pain or bleeding because they are dead. The fact is that the tissues left behind when a piece of shell has torn away a great mass of skin, cellular tissue and muscle, are either dead or partly devitalized over a very large area; and I have described how microscopical examination shows that the injury is really very much more extensive than it even appears to be. It is in the widely extravasated blood and in these dead and dying tissues that the anaerobic bacilli in particular find an unresisting prey, and it is a matter of daily experience that in the very large shell wounds of the shoulders and pelvic region, where amputation cannot be performed, gangrene almost inevitably supervenes. In simple flesh wounds it is quite rare.

Much of what I have said of the anaerobic bacilli is true also of the streptococcus, which is found in such large numbers by Mr. Fleming, for Sir Almroth Wright has specially pointed out that this organism, like the anaerobic bacilli, also grows with extreme rapidity. It is therefore evident that in the wounds in France there are at least two organisms with which in civil practice in England we are not familiar, and the whole group of fæcal bacilli has been hitherto comparatively unknown in modern surgery. It must, of course, be evident that the common pyogenic streptococci and staphylococci are also liable to infect wounds in France as well as in England.

But, important as are the nature of the wounds and of the microbic infection, if we are to realize to the full the conditions that favour the growth of organisms we must turn from the conditions of the wounds to the conditions of the patients, for the wounds that undoubtedly do the worst apart from the severity of

the injury are those in which the patient could not be rescued for some time, and has been left lying out and got thoroughly chilled, or has had severe bleeding, and these two conditions are often combined.

As I see it, the whole picture is much as follows: The man is wounded and simultaneously inoculated with organisms, which immediately fasten upon any dead tissue. The safety of the patient depends for the time on his own inherent ability to resist, and if he is collapsed from loss of much blood, and is wet, cold and starving, his leucocyte defence is enfeebled or absent; the bacteria grow unopposed, and either destroy the unresisting dead or partially devitalized tissues locally, or else, in addition, poison him by their toxins. The condition of the man himself to a great extent determines the reaction of the injured part and must be taken into consideration, together with all the local complications if the infections of wounds are to be really understood.

It is very natural, therefore, that suggestions should have been made for the application of an antiseptic agent by the wounded man himself or his comrades as soon as he is wounded. But, although such treatment sounds plausible, it is really perfectly useless, for not only would very large quantities of any agent be required for the numerous large wounds, but it would be obviously useless to employ them unless they could penetrate to all parts of it, and unless the wound could at once be protected from further contamination. If the man lies in the open he cannot generally get at his own wound at all, either because of its situation or because he cannot remove his clothes, while he is also tolerably certain to be shot if his movements show that he is yet alive. Or, if one pictures to oneself the wounded man lying in a deep and narrow trench, still covered by his muddy clothes, possibly in the dark, and perhaps with a broken limb, his own hands and those of his comrades grimed with mud, and no one knowing till clothing is removed where the wounds are situated or how numerous they are, it becomes evident that to apply antiseptics under these conditions is worse than useless, and no one familiar with these conditions would ever think of advising such treatment. It is indeed clear that the very best thing is to get the patient away as soon as is possible to some place where he can be thoroughly treated and kept in safety for a sufficient time, and in the British Army that place is in some cases the field ambulance, and in all the worst cases the casualty clearing station.

It is at this stage that we find there are two different schools

of thought amongst those who are not at the Front as to what is best to be done in the treatment of the wound. One school, which draws its experience mainly from the surgery of civil life, would persuade us that all our wounds, if properly treated, should be completely sterilized—at a single dressing if seen early enough—by the application of this or that antiseptic agent, and can only see in any subsequently septic wound evidence that the surgeon's work has not been done as well as it ought. The other school, which draws its limited experience from this present war, asserts that antiseptics are useless as such, and considers that they should not be used at all.

I am myself very decidedly of the opinion that neither school is right, and that, on the one hand, the badly infected wounds, in badly injured men, can seldom be completely sterilized at a single dressing, and, on the other hand, I am quite certain that antiseptics are useful and necessary for the proper treatment of all the wounds of war, and that they have been of the utmost service.

For many years I have been on the staff of St. Bartholomew's Hospital, and I have seen both the end of the pre-antiseptic days of surgery and the whole of the antiseptic period, since Lister's views became generally accepted. I have seen many changes in methods and practices, and I know full well that in each succeeding decade the results obtained by surgery have been better and better. Consider for a few minutes what is the practice which is commonly accepted as correct for a bad compound fracture of the leg caused by the wheel of a heavy vehicle. My own house surgeon would proceed much as follows: The patient would be deprived of his dirty clothes and washed, and would then be taken into an operating theatre where everyone would wear sterilized gloves and gowns. His skin would be shaved and washed with acetone or ether, and then painted with a two per cent solution of iodine in spirit. The wound would be enlarged if necessary; the dirty ragged skin edges and bits of torn muscle would be cut away: loose bone fragments would be removed; the whole wound would be thoroughly washed again and again with a solution of biniodide of mercury (which I prefer to perchloride because it does not coagulate albumen), sterilized or cyanide gauze would be applied and splints would be fitted to the limb.

And what would be the result? In my experience, in nine cases out of ten the fracture would heal as well as if there had been no wound, and the wound itself would heal either by first intention, if not too lacerated, or else by granulation with the minimum of

suppuration if it were extensive, and if some of the skin had been destroyed. What has the treatment effected? I should reply that it has at least mechanically cleansed the wound without adding to its previous contamination any microbes on the hands of the surgeon or on his instruments, and that, further, it has rendered harmless any bacteria in the skin of the patient and has both mechanically removed organisms already in the wound and has temporarily inhibited the growth of those remaining, so that the healthy tissues could quickly destroy them.

And if I am told that the antiseptics I have employed to the skin and to the wound itself have played no part, and that sterilized water would have done as well, I should reply that I know by experience that until we did use antiseptics very thoroughly we did not get these results, and that the wounds which have been treated in the manner described have done consistently better than those of previous years. I should add that practical experience has shown that suitable dilute antiseptics have never done harm, and that, consequently, there can be no possible objection to their use.

But if, on the other hand, I am taken to task as to why we cannot get as consistently good results in war as in peace, my answer is to be found in what I have said; namely, that in the first place neither the conditions of the patients themselves nor the character of their wounds are at all comparable; and in the second, that the microbic infection is also quite different from that in civil life.

And if the question be asked, Are, then, antiseptics to be used in the case of recently wounded men? and, if so, what good can be expected from them? I should unhesitatingly answer that, whenever possible, all these soiled wounds should be treated just as carefully and thoroughly by antiseptics as any dirty wounds would be in any great British hospital, and that exactly the same amount of good is to be expected in recent gunshot injuries from the cleansing of the skin and of the wounds. The ordinary pyogenic organisms, at least, can be eliminated in sufficiently early and favourable cases, and the patient has, in consequence, a much better chance in his fight against his new enemies. If we cannot kill all the bacteria there is no reason why we should not kill as many as we can, and, as we have in civilian practice already succeeded in sterilizing for all practical purposes by a single dressing very many of the septic wounds which we habitually treat, we naturally do not credit those who assure us, as a result of experimental evidence, that this cannot be done, and we not unreasonably hope

that we are already succeeding in finding better methods than we have hitherto possessed for the wounds of war and the anaerobic and fæcal infections. I altogether object to the attitude that antiseptics never have and never will overcome sepsis.

The line of treatment I have indicated above, with minor variations, such as more extensive excision of injured tissue, has been carried out in thousands of patients in this war, and I claim that practically all those who have had slight wounds, as well as many who have had serious wounds, have done exceedingly well. We have, indeed, had abundant evidence of this both in the way our patients have recovered, and also in the numbers of wounded men who have returned to the Colours, and it should be a satisfaction to everyone to know that, except when overcrowded by the rush of frequent battle, the conditions for the treatment of the wounded in well-equipped operating theatres are not one whit behind the best that can be found in civil life. No better work has been done during this war in the saving of lives and limbs than the thorough cleansing and dressing of severe wounds, whether complicated by fractures or not, and except for the very great difficulties inherent in warfare which I have already described, there is no more delay in conveying the patient to field ambulances and clearing stations than in getting a patient from an accident into a civilian hospital. I am also quite certain that it is most inadvisable to teach that no wound can ever be sterilized by the proper use of antiseptics; for in the first place the statement is contrary to the experience of surgeons for many years past, and in the second it is liable to discourage well-intentioned efforts.

But if it be asked whether the treatment I have advised can be relied upon to sterilize completely the large lacerated shell wounds and the bad compound fractures, the answer must be that up to the present time neither this nor any other treatment yet adopted and described in the armies of the enemy or of the Allies can claim to have accomplished this end in this class of injury by any single dressing or cleansing, even when the wound is treated at once. It is indeed a notable fact that no surgeon who is familiar with the wounds and conditions at the Front has ever made such a claim, and it is only those who know these wounds subsequently who are prepared with antiseptics which have each failed when put to trial. And it is for this reason, and with this knowledge, that we who see these men soon after injury say that such wounds should never be treated as if they had been rendered aseptic and as if they could be safely closed by suture. There is, of course,

no doubt that slight and simple wounds may be so completely excised that all infected tissue is removed and all the surrounding skin cleansed so thoroughly that primary aseptic union may ensue in a large percentage, but no such result as this has been obtained in the very large lacerated wounds where complete excision is an impossibility as a routine consequence of any method of disinfection at a single dressing. The best we can reckon on is that only after several or many days do the wounds become free from dead tissue and virulent bacteria.

It is especially in these cases of bad compound fractures and in the lacerations by shells that free drainage is so absolutely essential, and my colleague, Surgeon-General Sir George Makins, directed special attention to the need for this very early in the war. Colonel Burghard and Lieutenant-Colonel Sargent were each subsequently insistent, yet in spite of this it was some time before we could get free drainage universally adopted at the Front, and for the following reason: It became evident that some of the most recently qualified medical officers had been so much accustomed to deal with clean wounds which could be safely sutured, and had got so accustomed to obtaining union by first intention, that they could not believe that the gunshot wounds they treated had not also been satisfactorily sterilized. The fact is, that owing to the very success attending the practice of surgery in recent years, there was a certain amount of ignorance of septic wounds, an ignorance which is easily accounted for when one considers how very little suppuration is to be found in the wounds in all hospitals of the present day. But when sutures were finally given up and large drainage-tubes were used freely, all the wounds did better, and the stimulus supplied by the work of Colonel Sir Almroth Wright was of inestimable value in promoting sound practice on these lines. Let us clearly recognize, however, that the provision of efficient drainage is no new thing, and that it is, of course, quite easy to appreciate its benefits in the infections by anaerobes when we remind ourselves of the fact, on which I have already laid stress, that the anaerobes live mainly in dead tissue and are quickly killed by healthy cells. It is not material whether they find dead muscle or dead fluid, and the surgical principle that septic wounds should be drained is an established practice of surgery and was thoroughly understood in all its bearings long before the present war supplied so large a field for its use.

But while we should strive to cleanse all recent wounds, it must constantly be borne in mind by all military surgeons that the

longer the time that elapses between the infliction of the wound and the first thorough dressing, the more impossible does it become to obtain a good result. I have already pointed out the many reasons why and how this delay is so fatal, but all of them lead finally to one paramount reason, namely, that the longer the wound is left in its primitive state of blood-stained and crushed tissues contaminated by a bacteria-laden soil and muddy clothes, the more extensive and far-reaching is the growth of these micro-organisms, and the more impossible does it ultimately become to attack them with any hope of immediate success. The more likely also is the patient to be already infected beyond hope of recovery, and I have known men who, before they could be rescued, were already dying of the results of the infection by gas-forming organisms. How, then, are we to treat cases where advanced sepsis is definitely established beyond hope of early sterilization?

We have the choice between the hypertonic salt solution of Sir Almroth Wright and the use of antiseptics, and each of these has many supporters. The object of each is the same in reality, for it is recognized by the advocates of both that it is necessary for dead tissue to be disintegrated or cut off as sloughs, and for granulation tissue to grow before healing can take place; and as one watches the blood-stained unhealthy discharge from the dead and dying tissues give place to the formation of pus by healthy granulations, one appreciates more clearly than ever before why the older surgeons spoke of "pus laudabile et bonum." They understood that when the velvety granulations and the creamy fluid appeared, destruction had ceased and repair had begun, and we recognize to-day, as they did, that there is such a thing as a relatively "healthy suppuration."

I think that those who prefer antiseptic to saline treatment have found, as in all sloughing wounds and cellulitis of civil practice, that nothing is so good as prolonged immersion in an antiseptic fluid; but unfortunately most of the wounds are not so situated that this is possible. When this is the case, then the next best thing is to employ constant irrigation, and very many wounds have done exceedingly well under this method, whether saline or antiseptic fluids have been used. But whatever fluid is employed, every surgeon knows by an experience which is far more valuable than any other source of information that good results in complicated wounds can only be obtained if the treatment of the wound is varied according to its conditions. It can only be ignorance of wounds that would limit a surgeon to a single form of lotion, and it is the merest truism to say that in complicated and septic wounds a

change of lotion or other application is as necessary as is a variation in the diet of the patient.

It has seemed to me that the period during which the saline hypertonic treatment is useful is strictly limited to the separation of sloughing and unhealthy tissue, and that once a granulating surface is obtained throughout, it had better be abandoned, for it is generally painful, and if it is continued the skin becomes irritated, the granulations often become exuberant and flabby, and the healing process is correspondingly slow. The use of such well-tried applications as nitrate of silver and sulphate of zinc may then well prove more beneficial than that of the most potent solution of antiseptics or salines, for to treat wounds according to the daily report on their microbic infection, to the neglect of all else, is as foolish as it would be to treat every symptom of an illness rather than to treat the patient who is ill.

Within the past few months the treatment by solutions of hypochlorous acid has been most extensively tried, and the methods of producing it, advocated by Dakin and Carrel and Lorrain-Smith respectively, seem to most observers to be equally good. Personally, I may add that, as far as I have seen, there is nothing to choose between the two solutions, and I think I may safely say that almost all surgeons are pleased with the results obtained in the treatment of wounds, and many have given up other methods in its favour. Where wounds of the hands and feet have been immersed in the solution they have cleared up with great rapidity, and where extensive lacerated wounds and bad compound fractures have been treated by irrigation, many patients have done extremely well. I think that wounds of this class have done better under treatment by hypochlorous acid than under any other, but I cannot say that they have become sterilized as rapidly as the cases recently described by Carrel, and I do not think that the good results he obtained were in wounds of the class I specially refer to—namely, extensive lacerations by shells and bad compound fractures. It is, however, my very decided opinion that the hypochlorous acid treatment is an important advance, and I find that it has to a great extent displaced all other forms of treatment in many of the casualty clearing stations. It is generally believed to have prevented the occurrence of gangrene in many bad lacerated wounds and to have arrested its progress in others; and, although I am well aware that it has not always been successful, I consider that it has already been productive of very much good, and to be more useful in this class of wound than any other application we have

yet tried. It is also a very remarkable fact that, unlike most antiseptics, it can be used in solutions sufficiently powerful to destroy virulent microbes very quickly without at the same time injuring the tissue cells. It should, however, be only used in solution, for if used as a powder it, like many other powders, is liable to form hard lumps which obstruct free drainage and so counteract its good effects.

I have now, Mr. President, completed the task I set myself at the beginning of this lecture, and I have placed before you as well as I am able to do in so brief a space of time the circumstances and conditions of our wounded soldiers in France and Belgium, and the nature and treatment of their wounds.

But there remains yet a duty which I feel I owe both to the Army itself and to the medical profession at large, and that duty is to express to you how deeply I feel the whole country is indebted to the medical officers in whose hands are ultimately placed the duties of caring for our sorely tried soldiers. I do not propose to say one word about the general efficiency of the corps to which I have the honour to belong, for it needs no words of mine. What I do wish to say is that nothing has impressed me so forcibly or so favourably as the qualities of many of the younger surgeons on whom has rested the chief stress of the actual treatment of the wounded. There is not a medical school in Great Britain or Ireland that has not reason to be proud of its pupils, and the work of the surgeons has been equalled and supported by that of their pathological colleagues.

I do not know whether to admire most the energy and keenness which have enabled the staffs to work days and nights without adequate rest, or the technical surgical skill, in complicated and difficult operations on the abdomen and limbs alike, which has been so conspicuous a quality in so many officers. The care, and zeal, and patience displayed in efforts to save limbs and life have been no less praiseworthy than operative dexterity.

The Royal College has influenced or guided the teaching of surgery during many years, and all who have shared in this responsibility may feel a legitimate pride in the splendid work now being done by its pupils. "The tree is known by its fruit," and the future of British surgery is in safe keeping, for many of the best brains and hands which guide its course are yet young.

THE RELATIONSHIP OF THE MENINGOCOCCUS OF WEICHSELBAUM TO THE TRUE INFECTIVE AGENT IN EPIDEMIC CEREBROSPINAL FEVER.

By EDWARD C. HORT, F.R.C.P.Edin.; C. E. LAKIN, M.D., M.R.C.P.; and T. H. C. BENIANS, F.R.C.S.

[For the filtration and inoculation experiments here recorded, and for all the sections of this paper except No. 6, one of us is alone responsible (Hort). Individual responsibility for the purely bacteriological observations recorded in section 6 is indicated in brackets.]

(1) ANALYSIS OF THE CLAIMS OF THE MENINGOCOCCUS OF WEICHSELBAUM.

In a recent communication, we examined the evidence usually relied on in favour of the theory that the meningococcus of Weichselbaum is the primary infective agent in the disease known as epidemic cerebrospinal fever.

We showed that evidence derived from the production of meningitis in monkeys by injection of cultures of the meningococcus by the meningeal route is inadmissible on account of the readiness with which the condition can be set up in these animals by local injection of other organisms bearing no etiological relationship to the disease, cerebrospinal fever. And we also pointed out that meningitis is only an event, and not necessarily a constant event, in this disease. It follows from this that even the production of meningitis by injection of the meningococcus by other routes than the meningeal—a result not hitherto recorded—would not absolutely prove that this organism is the cause of cerebrospinal fever.

We then showed that the weight of the evidence derived from the good therapeutic results that may follow the injection of antiserums to the meningococcus is largely counterbalanced by the inconstancy of these results, as was well illustrated by the unhappy experience in this country in the epidemic of 1914-1915. Omission to use different strains of meningococcal emulsions in the preparation of antiserums, and the good results that occasionally follow the use of antiserums to parameningococcal strains, have both been urged in explanation of the failure of specific serum

therapy as a whole. Extensive trial of different varieties of anti-meningococcal serums has, however, so far not established their superiority to stock serums, and the fact that antiserums to the parameningococcus type of organism appear to be sometimes useful in typical attacks of cerebrospinal meningitis does not improve the position of those who hold that Weichselbaum's meningococcus is the cause of epidemic cerebrospinal fever.

We then pointed out that agglutinability of the meningococcus by a patient's serum—a notoriously inconstant event—is unreliable evidence that this organism, as we know it in laboratory culture, is the primary infective agent, inasmuch as in other diseases the so-called secondary invader is sometimes agglutinable as well as the causal organisms of these diseases. And, finally, we pointed out that mere constancy of presence of the meningococcus in acute cases of the disease and in primary and secondary contacts is not, unless supported by better evidence in other directions than at present exists, evidence that justifies acceptance of the claims that have been made on behalf of Weichselbaum's organism. As an instance of the danger of admitting constancy of presence of an organism as evidence of direct etiological relationship we cited the *Streptococcus conglomeratus*, an organism which few now believe to be the primary infective agent in scarlet fever. And in this connexion we might also have cited the frequency of presence of the *Bacillus Aertryk* in swine fever, and the fallacy of the assumption that this bacillus is therefore the cause of the disease—a fallacy only dispelled by Dorset and McBryde's demonstration that the true causal agent is a minute virus which had hitherto escaped detection. Notwithstanding recent controversy [2] on this subject Dorset and McBryde's claims still hold good. The frequent presence of the *B. Aertryk* in yellow fever, of the *B. exanthematicus* in typhus fever, and of the diplococcus of Foulerton in anterior poliomyelitis, affords additional illustrations of the danger of assuming direct etiological relationships from mere constancy of association.

In thus exposing the fragility of the claims of the meningococcus of Weichselbaum we were careful only to assert that its case is as yet unproven, as we were not then in possession of experimental data which would support a definite statement that this organism, as we know it in laboratory culture, is not the primary infective agent. On the contrary we insisted that, owing to the frequent association of the meningococcus with the disease the search for carriers of this organism should in no wise be abandoned, since whatever its relationship to the primary infective

agent ultimately proved to be, its presence was as yet our main guide to efforts at epidemiological control.

In the communication referred to, and on a subsequent occasion,[3] we also recorded certain preliminary experiments of our own, the results of which appeared to us to call for a full enquiry into the etiology of cerebrospinal fever on lines hitherto unexplored, and this particularly because of the non-critical manner in which Weichselbaum's organism had been widely accepted as the cause of disease.

(2) THE THEORY OF MUTATION IN THE BODY OF INFECTIVE BACTERIA INTO NON-INFECTIVE FORMS.

These preliminary experiments were designed to test in cerebrospinal fever the truth of a theory advanced by Hort in 1914, as a result of a study of the bacteriology of typhus fever. According to this theory, which he has since applied to the study of the primary infective agent in scarlet fever, and in streptococcal endocarditis, the morphology of bacteria as observed in laboratory culture is not necessarily a faithful index of their morphology as primary infective agents in the infected body. In typhus fever, for example, evidence had been produced that certain bacteria appear to exhibit a much more complicated morphological life-history in the infected body fluids than is suggested by their study under the artificial conditions of laboratory culture. It was found in fact that very minute organisms of a highly infective nature could, by the use of a special technique, be isolated from the body fluids, but that they declined to maintain this minute infective form to any extent when attempts at cultivation on solid synthetic media were made, though there was no difficulty in cultivating larger forms of similar morphology which proved to be relatively non-infective, and which appeared to represent later stages in the development of the minute forms. In this view therefore the meningococcus, as known in laboratory culture, might prove to represent one phase only in the life-history of an organism presenting a complex cycle. In other words the meningococcal phase might prove to represent merely a late relatively non-infective stage in the life-history of an organism which is chiefly infective in its earlier stages, that is to say, it is chiefly in these early stages that the organism is capable of reproducing the disease. In the light of such a theory the infective and non-infective stages of the meningococcus might be morphologically similar except as regards size, the earliest infective forms being more minute than the later

relatively non-infective forms. On the other hand the infective and non-infective phases might be totally dissimilar as regards morphology, including size, or the morphology of the earliest phases might be quite indeterminable owing to their being beyond the range of vision. In the former of these two alternatives a genuine pleomorphism would have to be established, whilst in the latter alternative pleomorphism when passing from the invisible to the visible would be impossible to demonstrate, though it might be inferred from its occurrence in later visible stages. But whether pleomorphism were established or not, assuming the theory of association of different degrees of infectivity with different morphological phases in bacterial development to be made good by experimental observations, an entirely new light would be thrown in cerebrospinal fever on the nature of the true causal agent, and a reasonable explanation offered of the so-called secondary invader, which many who regard the etiology of the disease as undetermined believe the meningococcus to be (Hamer and others).

The very term "secondary invader," though obviously applicable to such organisms as may, for example, invade the blood stream in grave systemic infections primarily caused by other organisms, is one that should be used with great care. In many such cases the term is quite legitimately applied, and the chief characteristic of such cases is the diversity and inconstancy of organisms, in any given disease, which may be rightly described as genuine secondary invaders. In the case however of certain other diseases such as typhus fever, scarlet fever, swine fever, and, perhaps, epidemic cerebrospinal fever, the essential characteristic of the so-called secondary invader in each of these diseases is not their diversity or inconstancy but their remarkable constancy. We have for example constantly occurring in all parts of the world the *Diplococcus* (or *Diplobacillus*) *exanthematicus* in typhus fever, the *Streptococcus conglomeratus* in scarlet fever, the bacillus of Aertryk in swine fever and the meningococcus of Weichselbaum in cerebrospinal fever. We have, it is true, insisted that mere constancy of presence of one type of organism in any given disease is not good evidence that such organism is itself the primary infective agent in that disease. But the constancy of presence of the so-called secondary invader in the four diseases mentioned, and in them only, is too striking to be a matter of accident. If therefore, it can be shown by animal experiment, as has been shown in typhus fever and in swine fever, and as we shall show in cerebro-

spinal fever, that the so-called secondary invader is relatively inert whilst filtrates of the infected body fluids are highly infective, the possible relationship of the secondary invader to the primary is worth investigation. This, therefore, is what we mean when we suggest that the theory that the meningococcus is not a genuine secondary invader, but represents only a late phase in the life-history of an unknown primary invader, is worth study. And the fact that the problem of the spurious secondary invader is raised in several diseases, of which those mentioned are only examples, appears to justify study of the applicability of the theory to all those diseases in which one type of so-called "secondary invader" in each disease constantly occurs.

(8) EXPERIMENTAL DATA SUGGESTING THAT THE THEORY WAS WORTH INVESTIGATION.

The first step in our investigation, therefore, was the search in the body fluids of acute cases of the disease for organisms other than the meningococcus, and especially for organisms (exhibiting a complicated life-history) which might or might not prove to be ancestors of the meningococcus. Attention was in fact particularly directed to the presence or absence of organisms capable of passage through bacterial filters, and of exhibiting pleomorphic activity.

Investigations soon showed that a minute organism capable of passage through Berkefeld filters and through Chamberland F filters, can be demonstrated in acute cases in the blood, cerebro-spinal fluid and urine. And we also found that both in filtered and unfiltered fluids of the same nature a Gram-negative bacillus which appeared to be highly pleomorphic, giving rise in some cases to Gram-positive diphtheroidal forms of unstable type, can sometimes be grown and isolated. And finally we recorded the fact that in addition to these organisms the diplococcus of Jaeger in both Gram-positive and Gram-negative phases is frequently present in, and isolable from, the three body fluids mentioned, as well as a minute Gram-negative coccus, and zooglœic masses composed of minute organisms of indeterminable morphology. The results obtained in this the first stage of our enquiry seemed to us to justify the prosecution of further stages, including not only a more detailed study of the cultural and biochemical properties of the various organisms noted, but also an investigation of their pathogenic properties in monkeys, and of their possible relationship to the meningococcus.

(4) CONFIRMATION OF THESE DATA BY INDEPENDENT OBSERVERS.

Before recording these further observations, which are still being pursued, it is satisfactory to note that our published experiments have been amply confirmed in their essential details, by five different sets of observers working independently of each other and of ourselves [4], [5], [6], [7], [8].

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(5) ADOPTION OF SPECIAL TECHNIQUE REQUIRED FOR STUDY OF THE PROBLEM.

(*A*) *Incubation before Inoculation.*

In our first papers we showed that adoption of the routine method of examination of cerebrospinal fluid in cases of cerebrospinal fever may give rise to fallacious results. By routine method in this connexion is meant the inoculation of suitable solid synthetic media, such as nasgar, with the centrifuged deposit of fresh cerebrospinal fluid, accompanied by microscopical examination of stained films of the fresh deposit. It is true that in large numbers of acute cases Gram-negative diplococci can be seen within the cells in films prepared from the deposit of fresh cerebrospinal fluid. It is also true that typical meningococci can be isolated and identified in many such cases by inoculation of nasgar or serum-agar, or other suitable medium, with the fresh deposit. But in the relatively small number of cases in which failure is met with the fluid is assumed, when the ordinary technique is adopted, to be sterile. Our experiments however, soon showed us the value of preliminary incubation of the cerebrospinal fluid, not only as regards the presence or absence of the meningococcus, but also as regards other organisms, organisms which if due care be taken in the collection of the fluid, can be reasonably assumed not to be extraneous. And what is here said in connexion with cerebrospinal fluid applies also, *mutatis mutandis*, to the blood and urine. It has often happened to us, for example, to find that specimens of fresh cerebrospinal fluid which gave negative results when examined by the ordinary routine, provided us after incubation with enormous numbers of intracellular and extracellular Gram-negative diplococci in films, and, after plating, of colonies which subsequent identification proved to be colonies of meningococci. We are satisfied in short, from the experiments we have already published, and which we have since amply confirmed, that it is never safe to pronounce

as sterile, *quâ* the meningococcus, any specimen of cerebrospinal fluid until it has been incubated for several hours before inoculation of the ordinary laboratory media. And this applies with equal force, provided that incubation is allowed to proceed for sufficient time, to the presence of the pleomorphic organism we shall subsequently refer to as the meningo-bacillus, to Jaeger's diplococcus, to a minute unplaced Gram-negative diplococcus, and particularly to what appear to be very minute Gram-negative organisms of indeterminate morphology, which occur in zoogloeic masses, and which require the use of special objectives for demonstration. On the other hand, we have often found that organisms of these various types can be seen in large numbers in incubated specimens of cerebrospinal fluid, but that they will sometimes decline to grow, or grow with difficulty, on any solid synthetic media employed, though they appear to grow in early cultures consisting of liquid media containing albumin, such as serum broth. There is in truth no question but that the flora of the cerebrospinal fluid in acute cases of cerebrospinal fever is often richer and more varied than examination of, and attempts at cultivation from, fresh samples would lead one to suppose. It must not, however, be imagined that we are suggesting that some of these organisms may not be isolated from specimens of cerebrospinal fluid examined in the ordinary way, as well as such familiar organisms as streptococci, pneumococci, parameningococci, organisms of the Pfeiffer type, and so forth. As a routine method, however, incubation of the suspected fluid before plating should be invariably carried out, in parallel, if desired, with the ordinary routine. Speaking in general terms, it is the omission of this simple precaution which is largely responsible for neglect of the possibility that the life-history of some bacteria in the infected body fluids is not so simple as it appears to be when they are cultivated and studied in the laboratory. Moreover, the facility with which colonies of the meningococcus can be cultivated from the fresh cerebrospinal fluid on suitable solid media appears to have been fatal to a critical analysis of its claims as the causal organism of the disease, and to be responsible for the relative neglect of other organisms equally deserving of study, which do not necessarily adapt themselves to the environment presented by solid media. And this is a source of fallacy not disposed of by the utilization of condensation fluid impregnated with products of synthetic media. We have laid some stress on the importance of incubation of infected body fluids before plating not merely because omission of this precaution leads to diagnostic

errors and to failure to recognize that bacteria may be possessed of a more complex life-history than is generally supposed, but also because demonstration of such complexity would obviously have a most important bearing on the stages in such life-history at which bacteria should be used for purposes of vaccine and of serum therapy.

The main objection to incubation of the cerebrospinal fluid before plating is the greater opportunity the procedure affords to growth of extraneous organisms. This can only be met by increased care in collection and storage of the fluid, checked by the individual experience of the observer.

B. *The Study of Pleomorphism.*

In the case of organisms of considerable size it is a comparatively simple matter to determine whether any given organism suspected of the possession of pleomorphic activities is in fact so endowed. For example, in the case of a large organism, such as the *B. perfringens*, it is possible to isolate an individual bacillus and to study its morphology side by side with the morphology of its descendants. And if in such case pleomorphism is established the genuineness of the phenomenon can be demonstrated by the fact of growth from a single organism. On the other hand, it appears to be well recognized to-day that in order to establish pleomorphic activity, the study of growth from single colonies is not sufficient, since single colonies may be simple or compound in nature. By the term simple colony is here meant a colony of morphologically similar organisms derived from a single ancestor of the same morphology ; and by the term compound colony is meant a colony of two or more types of morphologically dissimilar organisms, which may or may not be derived from a common ancestor.

In the case of compound colonies, consisting of organisms of dissimilar morphology which are not derived from a common ancestor, any such colony is in reality a simple colony which has become contaminated by admixture with individuals which did not primarily belong to such colony. In such case pleomorphism is, of course, apparent only, and not genuine. On the other hand, a compound colony may be composed of organisms of dissimilar morphology which are primarily derived from a single ancestor, and provided that this single ancestor is sufficiently large to make it possible to show, in the laboratory, that growth takes place from one organism only, demonstration of dissimilar morphology between it and its descendants justifies a positive statement of genuine pleo-

morphism. At the same time it appears that a compound colony, if composed of two or more types of dissimilar organisms derived from one single organism, may under certain circumstances as yet undefined give rise, when replated, to simple colonies of single types of organism which appear eventually to become stable and fixed, assuming that the same type of medium be employed. It follows, therefore, that at any given moment a compound colony consisting of dissimilar individuals derived from a single pleomorphic ancestor may be composed of some types which have not yet lost their pleomorphic function, and of others in which the function is in abeyance. The complexity, therefore, of the problem of pleomorphism, even in the case of organisms derived from a single individual of large enough size to ensure that growth has taken place from it, and from it alone, may be very great. By the use, however, of Barber's method of isolation of single large organisms, or by the use of fragments of cover-slips which can be picked off from culture plates and rejected till one organism only is present, the problem of demonstrating the occurrence of a genuine pleomorphism is not insoluble.

In the case, however, of minute organisms at or near the limits of the range of vision, the difficulties attendant on the study of pleomorphism by observation of growth from single organisms we have found so far to be insuperable. And the reason for this is—as study, for example, of the centrifuged deposit of incubated specimens of cerebrospinal fluid in cerebrospinal fever, and of culture therefrom in liquid albuminous media, soon shows—that every grade in size may be represented, from organisms only just detectable with the highest-powered lenses available to organisms well within the range of vision with relatively low-powered lenses. In isolating, therefore, single individuals of the smallest recognizable type, in order to test the question of pleomorphism, it is impossible to be certain that in picking up one such organism other organisms beyond the range of vision are not at the same time being collected. In the face of this uncertainty we have been obliged, in the case of these minute organisms, to abandon the attempt to cultivate from single individuals, and have been thrown back on the study of single colonies. This necessarily involves subplating from single colonies on a large scale in order to reduce to a minimum the chances of error introduced by the assumption that compound colonies are not always contaminated colonies; and to prove this large numbers of cases had to be taken with a view to determining how far constancy of the results obtained would justify positive statements that

extraneous organisms were or were not present. We have already pointed out how persistently very minute organisms, which can be seen to be present and which appear to be multiplying in the body fluids, may decline to establish themselves as such on solid media. In addition, therefore, to the study of single colonies on solid media of such organisms as will survive on these media, we have also to study the morphology in liquid media of organisms which will not so survive, and to determine what relationship, if any, there is between them. And the crux of our problem is precisely this, that whilst we believe the assumption that laboratory culture on solid media is a faithful index of growth in the infected body is unwarranted by the facts we have observed and recorded, we find the ordinary methods of bacteriological observation to be at present too crude to encourage the hope of solution by their use alone. We are driven, therefore, to rely to a great extent on the results of animal experiments, involving injection of laboratory cultures of the meningococcus, side by side with injection of the body fluids from which this organism has been separated by filtration.

If, for example, we were able to show that injections of the meningococcus—*viâ* other routes than the meningeal—were inert, and that injections of filtrates of the body fluids reproduced the disease, we should be in a position to strengthen to some extent the evidence in support of the theory that the meningococcus is only the end-point of the infective process. In such event, the constancy of presence of the meningococcus in cerebrospinal fever, otherwise unintelligible, would become a strong link in the at present somewhat weak chain of evidence afforded by bacteriological study alone, especially if we were able to cultivate the meningococcus from the body fluids of animals which had been injected with filtrates from which the meningococcus as such was absent.

(*C*) *Filtration Experiments.*

In the early days of the study of minute organisms, it was generally believed that filtrable organisms were necessarily invisible. Demonstration by numerous observers has, however, proved that many filtrable organisms can be seen with the microscope, and the term ultra-microscopic, as synonymous with filtrable, when applied to bacteria, is in consequence to-day but little used. On the other hand, the possibility that such ultra-microscopic organisms as may reasonably be believed to exist are not necessarily invisible in all stages of their development, does not appear to have been seriously

studied. And, conversely, as we have already pointed out, the possibility that visible organisms may in some diseases proceed from invisible ancestors also seems to have been ignored. Owing to the unfortunate fact that in many cases filtrability of an organism is not merely determined by its size, the use of the filter as a gauge of size is of little practical use in the case of organisms just within, or approaching, the range of vision. It is, therefore, impossible—with the filters at present available—to determine by filtration whether visible organisms have an invisible phase, or if invisible organisms, if such there be, are always invisible.

From this it follows that in attempting to solve the problem whether the meningococcus (which, as we shall show, appears to be incapable of producing systemic infection) is not derived from an invisible infective ancestor, the filter is of little direct value; and inasmuch as determination of the primitive size of an infective organism, suspected of pleomorphism, appears to be a more important matter than its ability to pass a given filter, which below a certain point affords no accurate information as to size, little use can be made of the filter in the direct study of pleomorphic activity. It is, however, not so much the principle of filtration which is at fault in attempting to measure organisms near the limit of vision, as our inability at present efficiently to standardize bacterial filters. In the case of laboratory cultures of an organism, such as the meningococcus with an average diameter of not less than one micron, the question of standardization is not so important as it is in the case of organisms nearer to the vanishing point of vision. But speaking generally, all filtration experiments with bacteria, as at present carried out, are crude experiments as regards accuracy of measurement of size, and study of the various stages of their life-history. And, necessary as they are, the ordinary precautions as to preliminary testing, age, standardization, testing with organisms of standard size, time expended in filtration, degree of pressure or exhaust employed, and so forth, are of little assistance in this respect.

In all our filtration experiments, therefore, we have realized the hopelessness of attempting directly to solve our problem by the use of unstandardized filters, and have used them merely as a means of separating large visible organisms from small visible and invisible organisms. In this way we hoped to be able to determine not only the infectivity of the filtrates, but also if meningococci did or did not develop from meningococcus-free filtrates on incubation, control observations showing that the meningococcus was unable to traverse the particular filters used.

For this purpose, Berkefeld filters are of little value, unless precaution be taken so to assemble the filter flasks and filters as to cut out the joints of the filters from the closed system of sterilized air. In all cases, therefore, we took this precaution, as well as in the case of the Chamberland filters we employed.

The necessity for this precaution which we adopted twelve months ago, before the publication of our last papers, was further shown by N. S. Fenny in April of this year.

This observer showed, for example, that in the Berkefeld V candles the average air leakage at the joint was represented by 1·5 lb. of air pressure per square inch, as against an average of 4·3 lb. pressure of the general flow of air through the body of the candle. Similarly, with the Chamberland candles he recorded an average of 17·8 joint leakage as against 23·9 through the body of the candle. The test was made, as originally advised by Bullock and Craw in 1909, by measuring the pressure of air as it is allowed to pass through the pores of the filter while immersed in water.

Previous to the publication of N. S. Fenny's observations, we had, however, not realized the importance of actually measuring in each case the general flow of air through the candle before assemblage, though we had in each case satisfied ourselves by testing under water that the candles selected for experiment were without gross flaw, and we carefully recorded the time expended, and the degree of exhaust employed, during the act of filtration.

In all future filtration experiments, we shall, however, record also before assemblage the general flow of air through the candle, by Bullock and Craw's method. Before leaving the subject of filtration, it is necessary to mention that if a filter be used simply as a separator of large organisms from small, it is inadvisable, in our view, to test the filter at the time of experiment by mixing with the fluid to be filtered an emulsion of an organism of standard size. If this be done, the filter is apt rapidly to become clogged with the testing organism and its products of growth, and the whole object of standardizing the filter, as far as may be, before deducing the results of the experiment is defeated, apart from the increased difficulty of passage of the organism under examination, caused by blockage with the testing organism.

In filtration experiments devised to investigate the question whether large non-filtrable organisms are or are not derived from small filtrable ancestors, the most convenient method of testing the efficiency of filters against passage of the larger organisms is to carry out the test at the end of the experiment instead of simultaneously

with it. (In the case of cerebrospinal fluid, the experimental volume of which is necessarily limited, it is of the utmost importance not to block the filter by introduction of test organisms, whereas in the case of large volumes, for example, of exudates, partial blockage by test organisms is not so important.) This necessarily involves re-assemblage of the filter and flask after sterilization and after treatment of the filter (in the case, for example, of a Chamberland F bougie) in the muffle furnace or blowpipe flame, in order to burn off the organic residue left in the interstices of the bougie. An attempt is then made to filter an emulsion of the meningoccus, to take a concrete case, in pure laboratory culture. If the meningococcus cannot be seen in, or cultured from, the filtrate secondarily enriched with a filtered albuminous fluid, and if it can be demonstrated in the filtrate from the cerebrospinal fluid in the final experiment, it may be fairly concluded that there is in the cerebrospinal fluid, before filtration, a filtrable organism, which is not the non-filtrable meningococcus of text-book description, but which is, nevertheless, its precursor. And, incidentally, the experiment shows that testing of the filter has been efficiently carried out.

In order to study the question of transition of small organisms to large, and of pleomorphism generally, by the use of the filter—acting as a separator—we also avoid, as far as possible, filtration of highly albuminous fluids. In the case of cerebrospinal fluid and of urine, this is an easy matter, and in the case of blood the lysed centrifuged deposit of organisms is washed free of blood albumin, as far as possible, and is finally emulsified in normal saline, before filtration is attempted.

(6) DETAILED DESCRIPTION OF ORGANISMS THAT MAY FREQUENTLY BE FOUND IN THE CEREBROSPINAL FLUID IN ACUTE CASES BY ADOPTION OF THE TECHNIQUE DESCRIBED.

(A) THE MENINGOBACILLUS.

Unfiltered. [E. C. H.]

A specimen of fresh cerebrospinal fluid from a severe case of cerebrospinal fever was collected on May 5, 1915. It was at once placed in an incubator, at a temperature of 37° C., where it remained till the following morning. A film prepared from the centrifuged deposit of the incubated fluid showed on May 6:—

(*a*) Myriads of Gram-negative diplococci resembling meningococci.

(*b*) A very small number of slender Gram-negative bacilli.

(*c*) Several Gram-negative zoogloeic masses which at first sight suggested masses of autolysing meningococci. Careful examination, however, showed them to be comprised of what appeared to be very minute Gram-negative organisms of indeterminable morphology, i.e., it was impossible to determine whether they were coccal or bacillary in form.

(*d*) No pus cells.

A nasgar plate inoculated on May 6 with the centrifuged deposit from the incubated fluid showed on May 7, after one night's incubation at 37° C., typical meningococcal colonies, as well as minute bluish-grey colonies which were readily emulsified, and which were found in film preparations to be comprised of Gram-negative diplococci, morphologically indistinguishable from meningococci. Owing to an oversight, further identification of the organisms in these two types of colonies was not pursued. On the same date, May 7, films prepared from the centrifuged deposit of the fluid incubated since May 5 showed:—

(*a*) Very large numbers of organisms resembling meningococci.

(*b*) A few Gram-negative bacilli.

(*c*) Numerous Gram-negative clusters of organisms possessing more clearly defined morphology than on the previous day.

On May 9, the centrifuged deposit of the cerebrospinal fluid incubated since May 5 showed:—

(*a*) Large numbers of meningococcal organisms, many of which only feebly took up the counterstain (neutral red).

(*b*) Large clusters of Gram-negative organisms with morphology difficult to determine; others with more definite morphology, but still very minute. In some clusters definite meningococci of normal size could be seen.

(*c*) A few Jaeger's diplococci.

(*d*) No Gram-negative bacilli.

On May 10 the centrifuged deposit showed:—

(*a*) Feebly staining ghosts of meningococci.

(*b*) Enormous clusters of minute Gram-negative organisms, stretching across several fields, showing scattered well-staining meningococci.

(*c*) No bacilli.

We are well aware that these zoogloeic masses of what appear to be very minute organisms may in reality be masses of agglutinated meningococci undergoing autolysis, or may be merely artefacts. And these obvious explanations are at first sight supported by the fact that multiplication cannot be demonstrated on solid

media, on which indeed survival, except possibly on first cultures, is undoubtedly difficult to secure. The phenomenon, however, has been noted by Hort, not only in cerebrospinal fever, but also, *par excellence*, in scarlet fever, in typhus fever and in streptococcal infections in infective endocarditis. In all these cases the zooglœic masses were primarily composed of extremely minute Gram-negative organisms of practically indeterminable morphology. And the proof that they were organisms he established by the facts that multiplication of the masses rapidly took place in serum broth, that individual organisms in these zooglœic masses gradually came into the range of vision as minute diplococci or diplobacilli, and that individuals near the periphery of the mass eventually became detached, when they could be studied as single organisms, and—in the case of the last three diseases—that they were highly infective when injected into monkeys, whereas control injections of uninfected serum broth had no apparent pathogenic effects.

Filtered. [E. C. H.]

On May 6, 5 c.c. of the fluid, after incubation for one night, were passed through a new Chamberland F bougie, the gauge indicating a negative pressure of 150 mm. Immediately after filtration of the cerebrospinal fluid a mixture of 18 c.c. of sterile normal saline and 2 c.c. of sheep's serum, previously tested for sterility, was passed through the same bougie with a negative pressure of 150 mm. The whole operation of filtration was completed within thirty minutes, at the end of which time the filtrate was placed in the incubator at 37° C. (technique).

On May 7 the incubated filtrate was highly turbid and was found to contain Gram-negative bacilli in very large numbers, in apparently pure culture. A series of nasgar plates was at once inoculated with the filtrate.

On May 8 the incubated plates were examined and on plate 2 was found:—

(*a*) A bluish haze comprised of very minute confluent colonies.
(*b*) Three or four isolated minute bluish colonies.
(*c*) A few semi-translucent small whitish-grey colonies.

Each bluish colony under the colony lens was noted to be transparent with dentate outline. The centre of each colony was slightly more opaque than the periphery. The small, whitish-grey colonies showed a stippled surface, were of a brown tint with transmitted light, and showed fairly regular outlines. Film preparations of individual bluish colonies showed them to be

composed of slender, Gram-negative bacilli, varying in size from very minute organisms to organisms one to two microns in length. The smallest organisms appeared to be coccal or diplococcal in form. Large numbers of the bacilli appeared to be coccating, resembling the "biscuit bacillus" form described by us previously. Films prepared from the bluish type of minute confluent colonies showed in addition to the slender "coccating" bacilli large numbers of deeply staining Gram-negative diplococci. A film prepared from a single whitish-grey colony showed extremely minute Gram-negative organisms of a cocco-bacillary nature.

On May 9 a single colony on nasgar plate 2 showed :—

(*a*) Gram-negative coccating bacilli.

(*b*) Typical meningococcal Gram-negative diplococci.

On May 10, a nasgar plate, inoculated from a single bluish colony on May 8, containing coccating bacilli, showed colonies of:—

(*a*) Typical meningococci.

(*b*) Gram-negative bacilli, some extremely small, of cocco-bacillary formation, others being fairly large coccating forms.

On the same day a film prepared from the centrifuged deposit of a tube of broth inoculated May 8 from a single bluish colony showed the larger and considerably shorter Gram-negative bacilli described in the next section, but no meningococci were found.

On May 11, in the specimen of filtered cerebrospinal fluid which had been continuously incubated since May 6, no organisms could be found, the bacillary and coccal forms described having apparently died out. No further subcultures, however, were attempted. The bacillary organism isolated from the filtered cerebrospinal fluid in this case was highly motile; it was pleomorphic; it did not liquefy gelatine or clot milk. It produced no indol, and was without action on lactose or saccharose. It produced a slight degree of acidity in glucose peptone water plus sheep serum, but was without action in mannite, maltose or inulin. It grew freely, however, in these sugars in peptone water plus sheep serum. It produced slight discoloration in milk, but unfortunately was not tested for agglutinability with serum from an acute case of the disease or with an antimeningococcal animal serum. It grew well at room temperature on nasgar on which it exhibited considerable vitality, both in primary cultures and in subculture on the same medium.

Other Strains of the Meningobacillus. [T. H. C. B.]

(1) A slender Gram-negative bacillus with an average length of about two microns. In old cultures long delicate leptothrix forms have been noted. The organism grows freely on nasgar, on

glucose ascitic agar, and on maltose ascitic agar, often producing a distinct bluish or greenish discoloration on nasgar. Growth on agar is slight. In broth or peptone water there is slight growth, with general turbidity of the medium. It does not produce acid or gas in lactose, saccharose, glucose, mannite or maltose in peptone water, but one strain produced slight acidity on glucose ascitic agar. As a rule, however, growth on glucose ascitic litmus agar and on maltose ascitic litmus agar, produced definite alkalinity. The bacillus appeared in all cases to be non-motile. One strain preserved its viability for several weeks without subculture. In our hands it has not exhibited agglutinability with either animal antimeningococcal serum, or with serum from cases of cerebrospinal fever.

(2) A stout Gram-negative bacillus varying greatly in length. In the shorter forms it is impossible to distinguish it from a coccus. In definite bacillary forms a diplobacillary appearance is often seen. Another common form is that of a stout bacillus, about four microns in length, exhibiting regular segmentations throughout its entire length, each segment on examination with a high power consisting of a pair of cocci. In other forms segmentation may occur only at one end of the bacillus, and a pair of cocci, or what appear to be single cocci, may be seen actually on the point of detachment.

Growth on agar is slight. On nasgar a delicate growth of bluish discrete colonies, semi-translucent in character, is usually seen. Under the colony lens individual colonies present an irregular edentate outline. The surface is flat, and the margin is slightly raised. In broth and in peptone water there is only a slight growth, with the granular deposit and clear supernatant fluids suggesting streptococcal cultures. It produces no acid in lactose, saccharose, glucose or mannite, in peptone water; on litmus glucose ascitic agar there is as a rule no discoloration. In one strain, however, isolated from the cerebrospinal fluid of a monkey injected intraperitoneally with the filtered (Chamberland F) cerebrospinal fluid of an acute human case of the disease, marked acid production in litmus glucose ascitic agar was noted. This strain was characterized by free formation of Gram-negative diplocooci. On litmus maltose ascitic agar the blue colour was invariably deepened as growth proceeded.

All the strains examined were non-motile. In old cultures, especially agar cultures, involution forms made their appearance. Long straight forms, long curved forms, very long leptothrix forms

(ten to twenty microns in length) and globular forms predominated. Each type presented Gram-negative (apart from dead organisms), and Gram-positive phases and long bacilli, parts of which were Gram-positive, whilst other parts were Gram-negative, were frequently seen. In addition, giant forms of cocci, resembling the giant forms of meningococcal cultures, were noted. The viability of the organism was much greater than that of the meningococcus, and it has even been cultivated from the cerebrospinal fluid eight weeks after its removal from the body.

Observations by Previous Observers on a Gram-negative Bacillus resembling the Meningobacillus.

An organism somewhat resembling the meningobacillus in its larger phases has been previously described in sporadic meningitis by D'Este Emery, by Professor Symmers and W. J. Wilson, and by J. A. Arkwright.

Emery, for example, in 1904 [9] recorded the fact that in the cerebrospinal fluid of a case of posterior basic meningitis he had noted the occurrence of highly pleomorphic diplococci showing bacillary forms.

Again, Symmers and Wilson recorded in 1909 [10] that in four cases they had isolated Gram-negative cocci (which were not meningococci) with short bacillary forms. These cocci showed no tendency to tetrad formation, but short chain formation was a marked feature. The organisms stained well, but there was no evidence of autolysis. Long, uniformly-stained, unsegmented threads were also present, the length sometimes reaching twenty microns. The organism grew well, both at 20° C. and at 37° C. and its viability was marked, even without subculture. It gave abundant growth in the Drigalski-Conradi medium. It did not ferment lactose, saccharose, glucose, maltose, galactose or lævulose. In one of the four cases mentioned it was recovered from the cerebrospinal fluid in pure culture. In the second and third cases it was recovered in conjunction with Weichselbaum's meningococcus, and in the fourth with an unplaced Gram-negative coccus.

And, finally, Arkwright, in 1909 [11], recorded similar observations to those recorded by Emery and by Symmers and Wilson. He described for example a Gram-negative bacillus which he obtained in pure culture, or almost in pure culture. From the cerebrospinal fluid in three cases of sporadic meningitis, in broth the organism appeared in the form of a short, oval bacillus, mixed with

larger forms. On agar the coccal form predominated, individual cocci being uniform and for the most part rounded. Double forms were also present, but not many of these suggested typical meningococci. In some fields one or two long bacillary forms were present. These stained more deeply with neutral red than did the coccal forms, and often showed segmentation (three and four segments). These bacilli were present in all the films examined, though occasionally very small numbers were seen. In older cultures they were more frequent. The organism did not ferment saccharose, glucose, maltose or lævulose. It made good emulsions in saline. In growth on agar and gelatine its colonies were transparent, and some became confluent. It caused uniform turbidity in broth, and grew fairly well in MacConkey's medium.

Morphological Variations of the Meningococcus.

As every student of the meningococcus of Weichselbaum is aware, one of the salient characteristics of this organism is its tendency to variation in size, grouping and staining properties. As pointed out by Heiman and Feldstein it is usually possible to demonstrate in ordinary laboratory cultures four distinct types of meningococcus. These variations do not, however, justify the application of the term "pleomorphic" to the meningococcus :—

(*a*) Well-staining cocci of normal size in pairs and tetrads.
(*b*) Feebly-staining cocci of normal size in pairs and tetrads.
(*c*) Intensely-staining cocci of normal size.
(*d*) Intensely-staining cocci four and five times the normal size.

The presence of these last, in giant forms, in cultures of about forty-eight hours old, is of distinct value in suggesting what the nature of a culture suspected of being meningococcal will, on the application of the classical identification tests, ultimately prove to be. It is, therefore, a matter of some interest to note, as we have already pointed out, that in cultures of the meningobacillus giant forms of deeply-staining Gram-negative cocci will constantly make their appearance in cultures of forty-eight or seventy-six hours old. We have already pointed out that these meningobacilli, when segmenting or coccating, will also give rise to crops of Gram-negative diplococci, which both in size, form and staining properties are indistinguishable from normal sized, normal shaped and normally staining meningococci. In the bacillary stage these organisms are, in some of their strains, biochemically somewhat similar to the meningoccocus in that they

decline to ferment lactose, saccharose and mannite in peptone water, and will ferment glucose ascitic agar and maltose ascitic agar, and occasionally glucose peptone water. In these respects the meningobacillus appears to be more closely allied to the meningococcus of Wechselbaum than it is to the chromogenic Gram-negative cocci, sometimes met with in the cerebrospinal fluid of acute cases of the disease, or to Dopter's parameningococcus. On the other hand, the meningobacillus will grow at room temperature, and its viability is considerable. However, it has in our hands so far shown no agglutinability with specific serums, and we have not yet tested the biochemical and serum reactions of the Gram-negative coccus to which the meningobacillus appears to give rise. The reason for this is that all attempts at separation of this minute coccus from cultures of the meningobacillus have, so far, consistently failed.

Before any definite statement can be made as to the true relationship of the meningobacillus to the meningococcus further study is required, but we believe that our observations on the subject here recorded justify complete investigation of the possibilities involved.

(B) JAEGER'S DIPLOCOCCUS. [E. C. H.; C. E. L.; T. H. C. B.]

Our experience of this organism, which we have repeatedly isolated from the cerebrospinal fluid, blood and urine of acute cases of cerebrospinal fever may be summarized as follows:—

It forms on all the ordinary solid media a delicate growth suggestive of streptococcal colonies. On nasgar plates, for example, after growth for twenty-four hours, the colonies average two to four millimetres in diameter. They may, however, be very much smaller than this. The larger colonies are of three types: (*a*) slightly raised in the centre, and at various points on the surface, the raised area being considerably darker in colour than the rest of the surface and sometimes showing (*b*) numerous black spots. The remainder of the surface of the colony is either finely stippled, or it may be quite pale, the colony being then translucent. A certain number of the colonies (*c*) are quite colourless, some showing raised, rounded margins, the appearance then recalling that of red blood corpuscles lying flat.

On peptone agar the growth is slighter and slower in development than on nasgar. In other respects the nature of the growth is very similar. In broth and in peptone water the growth is

slight, and sometimes collects in masses at the bottom of the tube, leaving the supernatant fluid clear.

The organism is non-motile and varies in its behaviour to Gram. To this point we shall return. It does not liquefy gelatin, does not clot milk and does not produce indol. It produces, as a rule, a slight amount of acid in lactose, saccharose, glucose, and maltose, and sometimes in mannite. Different strains, however, of the organism vary in their sugar reactions. It produces a slight degree of acidity in litmus glucose agar and litmus maltose agar. In liquid media lactose is sometimes unaffected and in glucose and maltose the amount of acid produced is always greater than in the case of saccharose. Glucose appears to be invariably fermented. The least amount of acid produced occurs generally in mannite, which with some strains entirely escapes fermentation. In litmus milk a definite acidity usually develops, but bleaching has not been observed. The agglutinability of the organism with serum from acute cases of the disease, and with animal antimeningococcal serum, we have not yet fully worked out. The results hitherto obtained have no definite significance. In films prepared from young cultures on nasgar the organism occurs in irregular groups. It also occurs as single cocci, as diplococci, and in tetrad form. It has a slight tendency to short chain formation. When occurring in groups, the organism shows great variation in size.

Its Behaviour to Gram. [E. C. H.; T. H. C. B.]

In the description of Jaeger's organism given by Besson it is stated that this organism is identical with the *Diplococcus crassus*, which is described as a Gram-positive organism, and by other modern authors Jaeger's diplococcus is considered to be one that always retains Gram's stain, notwithstanding the fact that in his original description of the organism in 1895 Jaeger clearly stated that it was sometimes Gram-positive and sometimes Gram-negative. So dogmatic, in fact, is the view of some writers that the organism is definitely Gram-positive, that it has been naively suggested that Jaeger's original cultures were mixtures of his own organism and Weichselbaum's Gram-negative diplococcus, the latter dying out and the former persisting. After careful study, however, of numerous strains of Jaeger's organism, we are satisfied that Jaeger's original description was correct, and that his diplococcus does vary in its Gram-fastness. It appears, in fact, that the modern error of describing organisms as definitely Gram-positive arises from the

habit of examining organisms—with reference to Gram-fastness—only after growth on the ordinary laboratory media. Experiment with this organism by repeated preparation of stained films in the transition form, from its more or less natural environment in the infected body fluids to the artificial environment of solid media, will soon convince the most sceptical of the accuracy of Jaeger's observations. If, for example, film preparations be made from incubated specimens of cerobrospinal fluid from acute cases of the disease, it will be often found that Gram-positive and Gram-negative diplococci are present side by side. If now a nasgar plate be inoculated, it will be found after a few hours' incubation that young individual colonies containing Gram-positive and Gram-negative individuals will both be present. If subculture be made on a second nasgar plate, and especially on a peptone agar plate, it will be found that the organisms are mainly Gram-positive, though in the case of the nasgar plate it will be found that there is present also a mass of Gram-negative débris, comprised of autolysing Gram-negative diplococci. If further subculture be made on peptone agar the colonies will eventually be found to consist entirely of definitely Gram-positive organisms, which appear to retain indefinitely their Gram-fastness in further subculture. At each of the later stages of this experiment the identity of the organism in question is of course established by biochemical tests. It is often stated that in examining organisms in respect of variable behaviour to Gram it is necessary to place on the same film for purposes of comparison an organism such as a streptococcus, which, in laboratory culture, is definitely Gram-positive. In the case of some types of organism which vary in their behaviour to Gram, this is, no doubt, a wise procedure, and one that we often adopt. In the case of this organism grown in media containing serum, provided that culture is made direct from the body fluids, there is a marked predominance of Gram-negative individuals as compared with growth on the ordinary solid media.

In the case, however, of Jaeger's organism such control is unnecessary, as experience of its behaviour in natural media, as compared with laboratory media, will soon show, inasmuch as in the first subculture from one to the other it is found that a perfect control is already present, on account of the tenacity with which some of the individuals in each colony hold the stain. And in subsequent cultures, as already explained, a control is no longer needed, on account of the rapidity with which the transition to colonies consisting only of Gram-positive individuals is effected.

In connexion with the variable behaviour of Jaeger's diplococcus to Gram's stain, an experiment was devised by one of us (T. H. C. B.) which brings out the interesting fact that the viability of the Gram-positive and Gram-negative phases on solid media appears to vary directly with their ability to hold the stain.

For example, a single colony from a nasgar plate was emulsified in water, and replated on nasgar. On the new plate three different types of colony appeared as described above under (*a*), (*b*), (*c*).

In colonies (*a*) and (*b*) the Gram-positive and Gram-negative organisms were about equal in number. In completely colourless and transparent colonies, however, of the (*c*) type, Gram-negative cocci were almost exclusively present, only an occasional Gram-positive organism being discoverable.

Subcultures were then made from each type of colony. In the case of colonies (*a*) and (*b*) the first subcultures showed in twenty-four hours abundant growth of colonies containing both Gram-positive and Gram-negative organisms, whilst in the subculture from type (*c*) growth was delayed for forty-eight hours and was then scanty. It appears, therefore, as if, assuming the possibility of mutation of Gram-negative into Gram-positive forms, it is only these Gram-negative forms which will survive repeated subculture that are capable of mutation, whilst those that retain their Gram-negative form will rapidly die out. On the other hand, the explanation may be that in all three types of colony the Gram-negative organisms are unable to survive repeated subculture on solid media.

The question, therefore, arises if this is a genuine example of chromatic mutation, or if the suggestion of mutation is merely the result of the existence of a compound colony in which two descendants of two ancestors are represented. Whether the latter is the correct interpretation, or whether the Gram-positive individuals in a single colony are originally mutated forms of Gram-negative individuals existing in the same colony—two descendants of one ancestor—can only be determined by culture from a single Gram-negative organism, a test we have not yet applied. On the other hand, the question whether Gram-positive individuals are capable of conversion into Gram-negative individuals capable of reproduction can also be only determined by growth from a single Gram-positive organism.

(C) Minute Gram-negative Coccus. [T. H. C. B.]

This is a very minute coccus, quite round and mostly lying in pairs, or in short chains. Chain formation was especially noted

in hanging-drop preparations. In cultures of a few drops autolysis was well marked. No involution forms or atypical organisms were noted. Growth in glucose and maltose ascitic agar was free, but there was no production of acid. In the case of maltose the growth produced a definite green coloration. Growth in peptone agar was fairly free, with production of green pigment. In broth and in peptone water there was fair growth. No acid was produced by growth in lactose, saccharose, glucose or mannite. The viability of the organism in subculture appeared to be slight, though the limits of viability were not determined. There was no evidence of agglutinability with anti-meningococcus serum, or with serum from an acute case of the disease. Only one strain, however, was tested against serums.

The cultural and biochemical behaviour of this organism is suggestive of Still's diplococcus.

INOCULATION EXPERIMENTS IN MONKEYS. [E.C.H.]

In all the animal experiments here quoted the injections were given by the intraperitoneal route. The object of choosing a route other than the meningeal was partly to avoid the obvious fallacy, already referred to, that the production of meningitis by local injection of the meningococcus is capable of throwing any useful light on the etiological relationships of the organism so injected to the disease, cerebrospinal fever.

The peritoneal route was also selected because of the successful results that have repeatedly been obtained by the intraperitoneal injection of monkeys with, for example, an adequate volume of blood collected from acute human cases of typhus fever. We began, therefore, by injecting blood from acute cases of cerebrospinal fever, the blood being collected during the height of the disease as early as possible after the symptoms had become fully established. In all cases the blood was collected direct into sterile citrate in hermetically sealed sterile flasks.

In all six animals were injected with blood from three cases. These animals were divided into two equal groups. In the first group each of the three animals received six cubic centimetres of a one in four mixture of venous blood and of 1·2 per cent citrate solution, the mixture being injected within an hour or two of collection. In each case the blood injected was collected from a different case of acute cerebrospinal fever, the diagnosis being bacteriologically confirmed.

Of these animals Monkey 2 gave a slight fever reaction lasting a few hours only on the seventh day after injection. This slight rise of temperature was succeeded by a sudden fall of 7° F. From this the animal rapidly recovered, and showed no further disturbance of temperature till the fifty-ninth day after injection, when it rapidly collapsed and died.

Bacteriological notes of the post-mortem examination of the cerebrospinal fluid of this animal are given below.

Of the remaining two animals in this group of three, Monkey 3 gave a slight fever reaction, lasting a few hours only, on the twenty-third day after injection. Apart from this, the temperature chart shows no variation from the normal for a period of fifty-four days, when observations were discontinued, except for a slight rise on the fifty-second and fifty-third days. The remaining animal in this group showed no disturbance of temperature for fifty-three days after injection, at the end of which time observations were discontinued.

In the second group of animals (three in number) each animal injected received an equal quantity of citrated blood from the same cases as in the first group, the only difference being that the blood was incubated for forty-eight hours at 37° C. before injection.

Of this second group Monkey 5 had unfortunately shown a slight degree of fever some ten days before injection, and if another animal had been available this monkey would therefore not have been injected. After injection this animal intermittently showed rises of temperature, which, however, within the fifty-one days of observation after injection were never higher than the highest temperature recorded before injection. At the end of fifty-one days the animal appeared to be none the worse for the injection, and observations were therefore discontinued.

Monkey 6 in this group showed a very slight rise of temperature on the eighteenth day after injection, which lasted for a few hours only. On the forty-seventh day after injection the temperature suddenly fell 6½° F., and on the following day the animal died. Bacteriological observations on the cerebrospinal fluid of this animal are recorded below.

The remaining animal (7) showed no rise of temperature for fifty days after injection, and observations were therefore at the end of this period discontinued.

So far as induction of continued fever is concerned, the injection of these six animals with fresh citrated blood, and with incubated citrated blood, was entirely without effect. The contrast between

this result and the results obtained by injection of fresh human typhus citrated blood is striking, and suggests that whatever the nature of the infective agent in cerebrospinal fever, it does not exist in sufficient quantities in the blood-stream to reproduce the disease in monkeys, after intraperitoneal injection. As regards the absence of effect, in so far as the production of continued fever is concerned, by intraperitoneal injection of incubated citrated blood from acute cases of cerebrospinal fever, the experiment suggests either that the meningococcus does not survive in sufficient numbers to produce fever when the citrated blood be used as the medium of growth, or that it was not present in the specimens injected; or that, if present, and capable of multiplication in the blood, it was inert as a producer of fever. As regards pathogenic effects other than fever produced by the injections, four of the animals appeared to be unaffected and two died.

At the post-mortem examination of Monkey 2 (C. E. L.) injected with fresh citrated blood, there were no signs of meningitis. A film prepared from the centrifuged cerebrospinal fluid showed, however, Gram-negative and Gram-positive cocci, suggesting Jaeger's diplococcus, as well as Gram-negative bacilli. Unfortunately, examination of these organisms was not carried farther.

At the post-mortem examination of Monkey 6, injected with incubated citrated blood, the following notes were made:—

Monkey 6. Post-mortem May 28, 1915 (C. E. L.). Cerebrospinal fluid from brain meninges, a film from the fluid showed no organisms (there was no excess of fluid). Fluid plated on nasgar.

Numerous small colonies grew, which, under the plate microscope, seemed to be identical. Films from these massed colonies showed Gram-positive cocci in pairs and tetrads, Gram-negative cocci in pairs—some about the size of a meningococcus, others very much smaller—and Gram-positive oat-shaped bacilli, both Gram-positive and Gram-negative.

These massed colonies were replated on nasgar, and five differing types of organisms were picked out and examined.

(1) A very minute Gram-negative bacillus growing heavily on nasgar, with a greenish filmy growth. On agar there was only very slight growth. On sugars there was no fermentation, but milk became discoloured and like dirty water. The organism was non-motile; it failed to agglutinate with serum from an acute case (in second week).

(2) A very minute Gram-negative coccus, growing well on nasgar, and on agar with a slight greenish tinge. The organism

in the sugar and in litmus milk gave no change; there was no production of indol. Growth on broth was fair, films showing the cocci to be lying in chains. Films from solid media showed the cocci to be lying singly, or occasionally to be disposed in small groups. The organism failed to pass through a new Berkefeld filter and failed to agglutinate with serum from an acute case.

(3) An organism of very varying form and varying relation to Gram's stain, fairly large Gram-positive and Gram-negative bacilli being noted. Some of the latter showed coccating segmentation forms and small numbers of large and small Gram-negative cocci were also present. In liquid sugars there was slight fermentation in glucose alone without gas formation. On solid maltose and glucose ascitic agar growth was fairly free; the former giving a dirty greenish colour, the latter a definite red colour. The organisms were non-motile.

After three weeks' growth on glucose ascitic agar films showed few bacillary forms, but large numbers of Gram-negative cocci, in appearance similar to the meningococcus as grown in artificial culture, although a few short rows of three or four to six cocci were to be seen. One or two small Gram-positive diplococcal forms were also present and there were one or two giant bacillary and diplococcal forms, the latter suggesting giant meningococci.

There was marked autolysis.

The organism failed to agglutinate with serum from an acute case. A glucose ascitic agar culture had retained its vitality after three months at room temperature.

(4) Gram-positive and negative grouped cocci giving acid in glucose, lactose, saccharose and mannite with a delicate growth in flat crenated colonies on nasgar and agar.

(5) A bright yellow coccus, staining deeply with Gram, with occasional Gram-negative members, growing very freely on agar and giving acid in glucose, lactose, saccharose and mannite.

In this preliminary examination no bacteriological observations were made on the various specimens of blood injected, it being considered that if a definite infective disease were set up in the animals injected it would be preferable to submit their body fluids to examination during life. Owing, however, to the absence of reaction in four animals, and to sudden death in the fifth, it was only possible to do this in the sixth animal which died the day after lumbar puncture. Apparently the bacillary organisms recovered post mortem in this case were merely leading a saprophytic existence, because strains of this bacillus when injected

into other monkeys produced no ill-effect, and even in this animal no disturbance was evident for forty-six days. We conclude, therefore, that its death was accidental.

Attention was then directed to the infectivity to monkeys of the cerebrospinal fluid of acute human cases of cerebrospinal fever. Experiments were therefore undertaken by injection of :—

(*a*) Fresh filtered cerebrospinal fluid (two monkeys).
(*b*) Incubated filtered cerebrospinal fluid (four monkeys).
(*c*) Fresh unfiltered cerebrospinal fluid (one monkey).
(*d*) Incubated unfiltered cerebrospinal fluid (one monkey).

As many of this group of animals were injected for purposes of control observation—to determine, for example, the relative effect of injections of incubated and of unincubated fluid—it will be convenient to describe these experiments in the following order :—

The Effect of Injection of Emulsions of the Meningococcus.

Animal 8 was injected with ten cubic centimetres of unfiltered cerebrospinal fluid twenty-four hours after lumbar puncture from a severe case of the disease. The bacteriological diagnosis was indisputable. The fluid was incubated between the times of collection and injection. One cubic centimetre of the fluid contained an hour before injection 920,000,000 Gram-negative diplococci, which were subsequently proved to be meningococci by the ordinary tests. A total number of 9,200,000,000 meningococci was therefore injected. That the cerebrospinal fluid contained living organisms in large numbers at the time of injection was proved by the profuse growth of meningococci obtained on nasgar plates inoculated from the incubated fluid. Beyond a slight rise of temperature occurring four days after injection, and which lasted only a few hours, the animal appeared to be quite unaffected by the injection. Observations were continued for twenty-one days after injection.

Animal 1 was injected with six cubic centimetres of cerebrospinal fluid from a severe case. The fluid was incubated for one night before injection. A sample of the same specimen of cerebrospinal fluid was examined after incubation, and was found to contain an enormous number of Gram-negative diplococci, which subsequently were found to be meningococci, and a small number of Gram-negative bacilli, which subsequently proved to be meningobacilli. The number of organisms injected was, however, not counted. Observations were taken for fifty-four days after injection, but no

fever reaction occurred on any single day, and the animal appeared to be unaffected in any way by the injection.

Animal 21 was injected with twelve cubic centimetres of a fresh unfiltered emulsion of tissue from the pons in cerebrospinal fluid from a fatal case of the disease, the tissue and the fluid being collected shortly after death. The diagnosis of cerebrospinal meningitis had been confirmed before death by isolation and identification of the meningococcus. Films prepared from the emulsion showed large numbers of meningococci and meningobacilli to be present, but no count was made. Viability of the organisms injected was proved by subsequent cultivation. The animal showed no signs of fever, or of other disturbance, for a period of four weeks after injection, at the end of which time observation was discontinued.

Animal 20 was injected with nineteen cubic centimetres of the same emulsion, after filtration, of pons tissue in cerebrospinal fluid containing meningococci and meningobacilli in large numbers, as in the case of Rhesus 21. No disturbance of temperature was, however, noted in the twenty-eight days following injection.

Animal 22 was injected with six cubic centimetres of the same unfiltered emulsion. In the twenty-eight days of observation no symptoms were noticed.

These four animals, then, were injected with varying doses of meningococci in a living state, but in no case did the animal injected appear to be affected by the procedure, and fever in all cases was conspicuously absent.

In strong contrast to the preceding are the results obtained by injection of animals 14 and 23 with the fresh filtrate from fresh specimens of cerebrospinal fluid from acute cases of the disease, the filter employed in each case being a new Chamberland F.

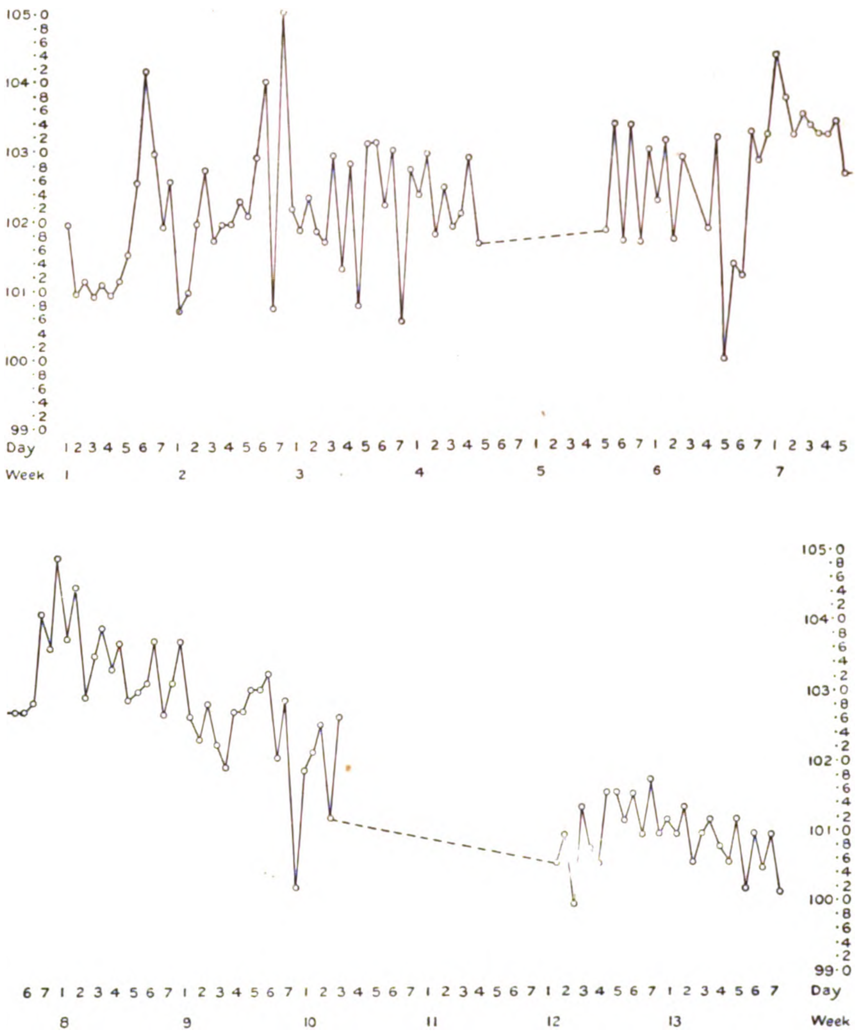
A. (*Vide Chart, Rhesus* 14.)

This animal was injected with fresh filtrate as above described. Observations were made in the case of this animal for eighty-five days after injection, with the exception of two intervals amounting in all to twenty days. As shown in the chart, continued fever of a marked type persisted for nearly the whole of this period. This animal was injected on May 9, 1915, and is now alive and well, the temperature for the past several weeks showing no departure from the normal.

In this case the composition of the filtrate was as follows: 4 c.c. of the fresh cerebrospinal fluid were mixed with 10 c.c. of

normal saline, and the mixture was at once passed through the filter with an exhaust not exceeding 500 mm. The procedure occupied four minutes. This filtrate was at once enriched by

RHESUS 14.



passage through the filter of a mixture of 10 c.c. of normal saline with 2 c.c. of sterile sheep serum, this secondary infiltration occupying a period of six minutes. 6 c.c. of the resulting

mixture were injected within two hours of the completion of filtration, the filter flask not being opened until the moment of injection.

A specimen of the unfiltered fluid was examined by film preparation from the centrifruged deposit for meningococci. No organisms could be found, though pus cells were fairly numerous. Forty-eight hours later the unfiltered fluid, which had been continuously incubated since collection, was once more examined, but again no organisms could be found in the centrifuged deposit. Further search for organisms in this specimen of unfiltered cerebrospinal fluid was not made, and in view of its persistent clearness, even after incubation, no attempts at cultivation were made.

A fresh specimen, however, of cerebrospinal fluid was obtained from this case twenty-four hours after the original specimen had been taken. This specimen when examined whilst still fresh contained a fair number of pus cells, many of which contained Gram-negative diplococci, which were also to be seen lying free. After incubation for twenty-four hours enormous numbers of Gram-negative diplococci were seen, both free and intracellular, the pus cells now presenting evidence of autolysis. Nasgar plates inoculated from this specimen of cerebrospinal fluid the previous day now showed numerous colonies of organisms, which proved to be meningococci. After incubation for yet another night, this second specimen of incubated cerebrospinal fluid was again examined and films from the centrifuged deposit showed :—

(*a*) Meningococci.

(*b*) A few meningobacilli.

(*c*) Numerous clusters of Gram-negative minute diplococci, the morphology of some of the organisms in some of the clusters being indeterminable.

We now return to the filtrate of the first specimen of cerebrospinal fluid obtained in this case.

After incubation for two nights of this filtrate, the fluid remained quite clear. After incubation for three nights the filtrate was distinctly turbid and contained :—

(*a*) A few minute Gram-negative cocci and diplococci.

(*b*) Gram-negative "coccating" meningobacilli.

The second specimen of cerebrospinal fluid was also filtered through a new Chamberland F after incubation for one night. The following morning the filtrate was found to be highly turbid, but was not examined microscopically till incubation had been allowed to proceed for another forty-eight hours. Films prepared from the centrifuged deposit then showed :—

(*a*) A few Gram-negative diplococci.

(*b*) Jaeger's organism.

A nasgar plate inoculated from this filtrate two days previous to microscopical examination of the centrifuged deposit now showed :—

(1) One colony of meningococci.

(2) Numerous colonies of Jaeger's organism, the Gram-negative phases being very markedly predominant.

At this stage, the patient received an injection into the spinal canal of Flexner's serum. On the following day a third specimen of cerebrospinal fluid was withdrawn. Immediate microscopy of the deposit of this specimen revealed no organisms. After incubation for a night the fluid was again examined, and films from the deposit showed :—

(*a*) Large numbers of meningococci within the pus cells which were already rapidly undergoing autolysis.

(*b*) Large numbers of "coccating" Gram-negative meningobacilli, both free and intracellular.

A nasgar plate inoculated the day before with the centrifuged deposit from this third specimen of cerebrospinal fluid showed large numbers of very minute semi-transparent colonies, with clearly defined edges and finely stippled surfaces. Films from these colonies showed :—

(*a*) Gram-negative and Gram-positive cocci.

(*b*) Gram-negative bacilli.

(*c*) Involution forms partly Gram-positive and partly Gram-negative, such as described in our first two papers, and subsequently by Donaldson.

This animal (Rhesus 14) which had been injected with the filtrate, the bacteriology of which has just been described, would have been of greater interest if it had been possible to examine the body fluids bacteriologically during the fever produced by injection. But in order to obtain sufficient blood for the purpose, cardio-puncture or arterio-puncture would have been necessary, venu-puncture in monkeys, without exposing a large venous trunk, providing too small a volume of blood.

Cardio-puncture in monkeys often involves the death of the animal, and consequent loss of valuable material. Arterio-puncture is also not a procedure that can be recommended if it is desired to keep intact the fever reaction which injection is primarily designed to study, the operation of exposure of an artery of sufficient size frequently leading to an abrupt reduction of the fever from shock. This animal during its illness showed no clinical signs of

meningeal involvement and its eventual recovery precluded local examination.

Animal 23 received an injection of forty cubic centimetres of fresh filtered cerebrospinal fluid (new Chamberland F) from the fatal case which supplied the material for injection of animals 20, 21, 22. Forty-eight hours after injection the animal was found in a state of extreme opisthotonus, which was maintained till its death a few hours later.

Bacteriological Notes Post-mortem (*Macacus* 23). — On post-mortem examination undertaken within three hours of death no naked-eye signs of meningitis were apparent. The lateral ventricles of the brain were opened with aseptic precautions, and one-half of a cubic centimetre of the ventricular fluid was spread over a nasgar plate. After incubation for twenty-four hours two types of colonies were noted.

A film from one of the smaller colonies showed Gram-positive and Gram-negative cocci, as also did a film from a single colony on a slope of glucose ascitic agar inoculated from a single colony on the nasgar plate. A film from a single colony of a further subculture on maltose ascitic agar showed Gram-positive cocci to be predominant, whilst a film from the same slope two days later showed an almost complete absence of Gram-negative individuals. A single colony from this slope was emulsified and litmus milk, lactose, glucose, saccharose and mannite were inoculated from the emulsion. Acid was produced in all the sugars, but no change was observed in the litmus milk. The organism appeared therefore to be Jaeger's diplococcus. A film prepared from one of the larger colonies noted on the original nasgar plate showed Gram-negative bacilli mixed with very long Gram-negative curved leptothrix forms. No change was produced by this organism in glucose, lactose, saccharose, or mannite; but acidity was produced on litmus glucose ascitic agar. On subculture on glucose ascitic agar a growth was obtained, a single colony of which gave Gram-negative bacilli which were not segmenting. On further sub-culture in maltose ascitic agar films now showed Gram-negative "coccating" bacilli mixed with Gram-negative diplococci indistinguishable in appearance from meningococci. Owing to an oversight these cocci were not tested in any way.

One strain of Gram-negative bacillus isolated was undoubtedly the meningobacillus previously described.

We have said that in the case of animal 14, the injection of fresh filtered cerebrospinal fluid produced a continued fever, lasting

many weeks, and that no organisms could be found in an unfiltered sample of the same specimen of fluid whether this sample was incubated or not. We also noted that while no organisms could be found in the fresh fever-producing filtered fluid—which at the time of injection was perfectly clear—the same fluid from which the inoculum was taken showed after incubation the presence of meningobacilli, and of organisms which appeared to be meningococci. In order to determine if incubation had any effect on the infectivity of the filtrate, animal 10 was injected with ten centimetres of the filtrate forty-eight hours after incubation. In spite of the fact that in animal 14 injection of clear fresh filtrate, in which no visible organisms could be demonstrated, produced a continued fever lasting many weeks, the injection of a sample of the same filtrate, now turbid from the number of organisms present, produced in animal 10 no fever during the period of observation of twenty days. The meningobacillus in late culture, the predominant organism present, appears from this experiment, therefore, to be as innocuous—when injected intraperitoneally—as the meningococcus appeared to be in the experiments already quoted.

In order, however, to determine if the absence of fever reaction was merely the result of injection of too small a dose, a fresh animal was injected with a massive dose of an emulsion of meningobacilli, isolated from the cerebrospinal fluid of another case of the disease. After observation of this animal for forty-one days after injection (less seven days owing to illness of the attendant) no fever or other systemic disturbance was noted. Later in the year two additional monkeys were injected hypodermically with massive doses—six agar slopes in each case—of the meningobacillus, and within the short limits of observation in these two animals (eight days) no rise of temperature was observed. In one case the meningobacillus had been recovered from monkey 6, which had died after an injection of blood from an acute case of the disease, and an opportunity for increase of virulence of the organism had therefore been allowed.

Taken together these four experiments certainly suggest that whether injected subcutaneously or intraperitoneally, the meningobacillus in late cultures is as harmless as the meningococcus of Weichselbaum.

Taken as a whole the conclusion which it appears to be reasonable to draw from these preliminary inoculation experiments is that the infectivity to monkeys of cerebrospinal fluid from acute cases of epidemic cerebrospinal fluid is in no way dependent on

the presence of meningococci or meningobacilli. On the contrary, the experiments appear to indicate the presence in the cerebrospinal fluid of a minute organism (capable of passage through Chamberland F filters) which is highly infective, and which is possibly the precursor of the meningococcus of Weichselbaum and the meningobacillus we have described.

Beyond this we are not, from the observations we have hitherto recorded, entitled to go.

CONCLUSIONS.

(1) The theory that the meningococcus of Weichselbaum is itself the primary infective agent in the disease epidemic cerebrospinal fever is not warranted by the evidence at present available.

(2) On the contrary, the experimental evidence here recorded distinctly suggests that the meningococcus is not itself the primary cause of the disease.

(3) The bacteriological observations here recorded appear to justify further research into the biological relationship of the meningococcus to the at present unknown primary infective agent.

(4) The fresh filtrate of fresh cerebrospinal fluid from acute cases of the disease was in two cases found to be highly pathogenic, and it is therefore possible that the true causal agent of the disease may prove to be a filtrable virus.

(5) Incubation of a filtrate, infective in the fresh condition, appears to destroy its infectivity, notwithstanding the fact that it may be after incubation crowded with living organisms which cannot reasonably be held to be contaminations.

(6) Late cultures of the meningobacillus appear to be as innocuous—as regards reproduction of the disease—as the meningococcus, when injected intraperitoneally.

(7) The meningobacillus and the meningococcus appear in some respects to be closely related

(8) For purposes of routine search for the meningococcus, and of estimation of the true bacterial content of cerebrospinal fluid in this disease, this fluid should be incubated before inoculation of solid media, in parallel with the ordinary method.

(9) Search for the presence of a filtrable virus, and examination of the question of the latter being the ancestor of pleomorphic descendants, should be carried on in conjunction with experimental inoculation of suitable laboratory animals, such as monkeys.

(10) Jaeger's organism appears, as he originally claimed, to be possessed of both Gram-positive and Gram-negative phases.

INFLUENCE OF RESULTS OBTAINED ON EPIDEMIOLOGICAL CONTROL OF THE DISEASE.

(1) The search for, and isolation of, carriers of the meningococcus should be rigorously carried on as heretofore, because although the meningococcus appears to be a harmless organism as regards reproduction of the disease its presence is nevertheless an invaluable danger-signal that the true infective agent is, or has been, present.

(2) Since the meningococcus is apparently not itself the cause of the disease it would seem to be unnecessary to attempt its destruction in the nasopharynx by sprays, meningococcal vaccines, implantation of pneumococcal emulsions, etc.

(3) Research to determine the true infective agent, whether biologically related to the meningococcus or not, is imperatively demanded, attention being specially directed to filtrable organisms in the nasopharynx, cerebrospinal fluid and blood of acute cases.

(4) If the infectivity of such filtrates be confirmed by future experiment, an attempt should be made to provide an efficient antiserum by the use of the filtrate as antigen.

(5) The theory that the meningococcus represents a late stage in the life-history of the primary infective agent deserves further study, not only on account of more obvious considerations, but also in view of its possible bearing on the problems presented by such phenomena as the curve of the epidemic.

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THE BACTERIA OF GANGRENOUS WOUNDS.

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(Report to the Medical Research Committee.)

The cases which provided the material for this investigation were selected from those undergoing treatment at the Third Northern General Hospital. The injuries were of a severe nature and in nearly all the cases there was evidence of the presence of necrotic or gangrenous tissue in the wound. Comparatively few, however, presented the clinical features of emphysematous gangrene.

Methods Employed.

The material used for examination consisted of fragments of necrotic tissue or of the discharges from the deeper parts of the wound. In some cases a piece of tissue was removed during an operation, in others swabbings were taken. Care was taken to avoid, as far as it was possible, contamination from surface organisms. In some cases a complete bacteriological examination was made, in others attention was devoted to the anaerobic micro-organisms alone.

The procedure usually adopted was as follows: (1) Films were prepared and stained by Gram's method. Additional films were in several cases stained with Leishman's stain, with Loeffler's methylene blue and by other methods. Attention was directed to the cells and to the appearance and numbers of bacteria present in the discharge.

(2) *Methods for the Isolation of Aerobic Organisms.*—Blood agar plates were inoculated and examined after incubation for periods of twenty-four and forty-eight hours. Subcultures were made from the resulting colonies and the different varieties of bacteria were identified by the usual routine methods. In a few cases plates poured with MacConkey's neutral red lactose bile salt agar were employed, in addition to the blood agar plates.

Methods for the Isolation and Identification of Anaerobic Organisms.

A tube containing about five cubic centimetres of broth was heavily inoculated with the material to be examined. In some cases a small piece of necrotic tissue was placed bodily into the tube, in others the material present on one or two swabs was thoroughly emulsified in the broth. In place of broth the following medium was employed on several occasions.

Egg Broth.—The white and yolk of one egg were thoroughly beaten up by vigorous shaking in a stout glass bottle containing a liberal supply of glass beads. Three hundred cubic centimetres of distilled water were then added and the mixture was thoroughly shaken. The bottle containing the mixture was then placed in a water bath which was slowly brought to the boil. This temperature was maintained for half an hour. During the whole period of heating the bottle was constantly and violently shaken. The result was a loose porridge-like mass consisting of finely divided particles of egg suspended in fluid. The medium was distributed in quantities of fifty to one hundred cubic centimetres in wide-mouth bottles which were plugged and sterilized in the autoclave.

"Egg broth" prepared in this way proved to be very useful as a culture medium for the growth of anaerobic micro-organisms. It is particularly useful for the growth of *Bacillus œdematis maligni.*

This egg broth or ordinary nutrient broth, after liberal inoculation, was heated for half an hour at a temperature of 80° C. It was then incubated in a Bulloch's chamber at 37° C. for periods which varied from two to twenty days. After this preliminary incubation—

(1) Films were prepared, stained and examined.

(2) Guinea-pigs were inoculated subcutaneously with one or two cubic centimetres of the broth.

(3) Agar, blood agar, or glucose agar plates were prepared, inoculated from the broth, placed in a Bulloch's chamber and incubated for a period of three to seven days.

It was found that glucose agar was the most suitable medium for these anaerobic plate cultures. Subcultures from the resulting colonies were made on Dorset's egg medium which proved admirably adapted for the needs of *B. aerogenes capsulatus* and *B. œdematis maligni.* It is probably better to subculture tetanus on glucose agar. The cultural characteristics of the various strains of anaerobic bacteria were examined on various culture media.

The examination of the aerobic organisms provided results of little or no interest and was not undertaken in every case.

Short Account of Cases.

Case 1.—Corporal E. C. E., aged 27, shrapnel wound of the back. Patient was wounded in the back by a fragment of a shell on September 14. A field dressing was applied, after which he lay for three days in a stable without further attention. At Boulogne fragments of shell were extracted from the wound. He was transferred to England, and on September 25 he was admitted to the Third Northern General Hospital, Sheffield.

Condition on Admission.—Patient presented a large and deep lacerated wound of the left lumbar muscles in the floor of which the lamina and transverse process of the fourth lumbar vertebra were exposed. The wound was in a very unhealthy condition, with its walls covered with a greyish-coloured slough. The discharge from the wound was scanty and foul-smelling. The tissues round the wound were inflamed and œdematous. Three days after admission patient developed tetanus, the symptoms of which continued with varying severity from September 28 to October 12. Antitetanic serum was injected subcutaneously at intervals; about 20,000 U.S. units in all being given.

Patient was convalescent and discharged from hospital on November 11.

Bacteriological Examination.—Films prepared from the discharge showed numerous polymorphonuclear leucocytes and a few large mononuclear cells of the endothelial type. There were numerous red blood corpuscles and a few small round cells. Cells were occasionally found which showed a small round nucleus and a definitely basophilic cytoplasm. The only micro-organism found in the films was a small Gram-positive diplococcus which was present in great numbers. Active phagocytosis had occurred and many of the leucocytes contained enormous numbers of these cocci.

Aerobic cultures were not made in this case.

Anaerobic cultures: A tube of ordinary broth was liberally inoculated with the discharge, heated for twenty minutes at 80° C. and incubated under anaerobic conditions for two days. The broth was then found to contain a large number of large, slender, actively motile bacilli. Some of these contained oval spores situated near one pole of the bacillus. These bacilli were Gram-negative. There were also a few Gram-positive short stout rods occurring singly

and in pairs. A prolonged search revealed a few bacilli with round absolutely terminal spores.

Two guinea-pigs were given a subcutaneous inoculation of one cubic centimetre of this broth. Both died within twenty-four hours. The condition was that of emphysematous gangrene, there was extensive œdema, the subcutaneous tissues being infiltrated with putrid blood-stained fluid. There was but slight gas formation. Agar plates smeared with fresh blood were inoculated from the broth and incubated for three days under anaerobic conditions. From the resulting colonies pure cultures were obtained of *B. œdematis maligni* and of *B. aerogenes capsulatus.* No tetanus colonies developed. The original broth culture was incubated under anaerobic conditions for another eight days. Subcutaneous inoculations of one cubic centimetre of the broth were made into four guinea-pigs. All these animals became very ill during the first twenty-four hours with considerable œdema at the site of inoculation. One died within the first twenty-four hours, but the other three had completely recovered within forty-eight hours. The three animals were kept under observation for some months but developed no signs of tetanus.

The case was clinically one of tetanus. The tetanus bacillus was not isolated and its presence was not demonstrated in any satisfactory way. The presence of a few bacilli in films which show a morphological resemblance to tetanus bacilli is, in our opinion, not sufficient to establish a diagnosis from a bacteriological standpoint. Exactly similar forms are seen in pure cultures of the bacillus of malignant œdema and *B. aerogenes capsulatus.*

The micro-organisms present in this case were a Gram-positive diplococcus, *B. œdematis maligni* and *B. aerogenes capsulatus.*

Case 2.—Private A. L., aged 33, shrapnel wound of the left upper arm. The patient was wounded on October 26, and admitted to the Third Northern General Hospital, Sheffield, on November 1.

Condition on Admission.—There is a small lacerated wound on the posterior aspect of the left upper arm. The whole of the arm is œdematous and swollen, and the tissues surrounding the sloughing and exceedingly septic wound are puffy, of a mottled appearance, and crepitate on applying firm pressure with the finger. The general condition of the patient is bad. November 2, 2,000 U.S. units antitetanic serum injected subcutaneously. The wound was opened up, and over a pint of thin pus burst out with great force from the deeper tissues; the fluid was frothy, very foul smelling and dark in colour. The patient rapidly became worse and died on November 5.

Bacteriological Examination.—Films from the discharge showed that the cells had been almost entirely disintegrated, the remains of polymorphonuclear leucocytes could be just recognized. The film showed large numbers of a small Gram-negative bacillus, which had every appearance of being *Bacillus coli*. Gram-positive diplococci were present in less number. There were fairly numerous short stout rods, with square cut ends, apparently encapsulated, occurring singly and in pairs. These forms were Gram-positive. Other forms, somewhat longer, occurred which were Gram-negative but showed an extensive and characteristic Gram-positive granulation. Both these are forms in which the *B. aerogenes capsulatus* occurs. There were also fairly numerous Gram-negative filamentous forms. In some the appearance was that of a continuous fibril, in others that of a chain of long slender bacilli. Some of these bacilli showed oval almost terminal spores.

Aerobic cultures: Blood agar and MacConkey's neutral red bile salt lactose agar were employed. From the plates were isolated a streptococcus which grew in fine translucent colonies and appeared in films from blood agar cultures in the form of short chains of four and six members. There was also isolated a strain of *B. coli* fermenting cane sugar, glucose, lactose, mannite and dulcite with production of acid and gas, having no action on adonite and inulin, producing indol, and clotting milk with the production of an acid reaction.

Anaerobic cultures: Ordinary beef broth was heavily inoculated with the discharge, heated for twenty minutes at 80° C. and incubated under anaerobic conditions for two days. Films were made from the broth which was found to contain numerous short rods which were recognized as *B. aerogenes capsulatus* and a very few chains of slender Gram-negative bacilli. Two guinea-pigs were inoculated subcutaneously with one cubic centimetre of this broth culture; both died within twenty-four hours with well-marked emphysema and œdema. From the broth glucose agar plates were inoculated. These plates together with the original broth culture were placed in a Bulloch's chamber and returned to the incubator. After four days' incubation the plates were found to be covered with colonies of *B. aerogenes capsulatus* in pure culture. Subcultures were made on Dorset's egg medium. At the same time films were made from the original broth which had now been incubated in all for a period of six days. The appearance of the film differed distinctly from that of the film made from the same broth four days earlier. The short forms of the *B. aerogenes*

normal saline, and the mixture was at once passed through the filter with an exhaust not exceeding 500 mm. The procedure occupied four minutes. This filtrate was at once enriched by

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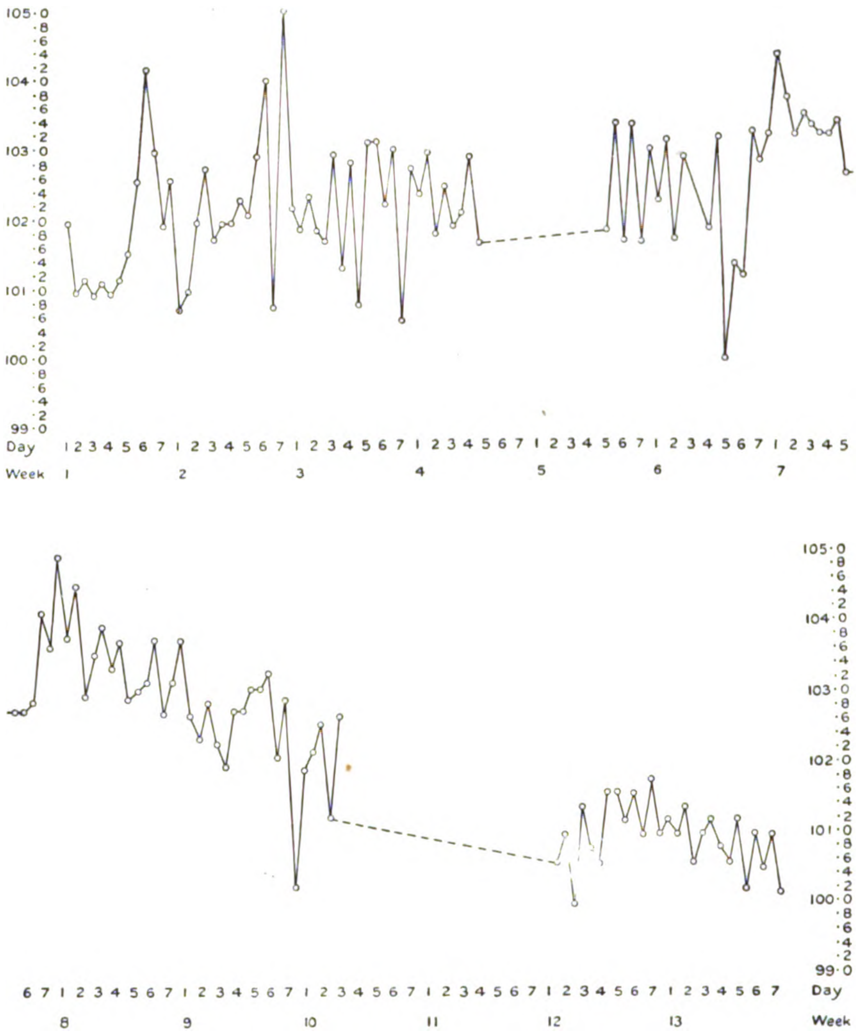

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A fresh specimen, however, of cerebrospinal fluid was obtained from this case twenty-four hours after the original specimen had been taken. This specimen when examined whilst still fresh contained a fair number of pus cells, many of which contained Gram-negative diplococci, which were also to be seen lying free. After incubation for twenty-four hours enormous numbers of Gram-negative diplococci were seen, both free and intracellular, the pus cells now presenting evidence of autolysis. Nasgar plates inoculated from this specimen of cerebrospinal fluid the previous day now showed numerous colonies of organisms, which proved to be meningococci. After incubation for yet another night, this second specimen of incubated cerebrospinal fluid was again examined and films from the centrifuged deposit showed :—

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(*a*) Large numbers of meningococci within the pus cells which were already rapidly undergoing autolysis.

(*b*) Large numbers of "coccating" Gram-negative meningo-bacilli, both free and intracellular.

A nasgar plate inoculated the day before with the centrifuged deposit from this third specimen of cerebrospinal fluid showed large numbers of very minute semi-transparent colonies, with clearly defined edges and finely stippled surfaces. Films from these colonies showed :—

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A film from one of the smaller colonies showed Gram-positive and Gram-negative cocci, as also did a film from a single colony on a slope of glucose ascitic agar inoculated from a single colony on the nasgar plate. A film from a single colony of a further subculture on maltose ascitic agar showed Gram-positive cocci to be predominant, whilst a film from the same slope two days later showed an almost complete absence of Gram-negative individuals. A single colony from this slope was emulsified and litmus milk, lactose, glucose, saccharose and mannite were inoculated from the emulsion. Acid was produced in all the sugars, but no change was observed in the litmus milk. The organism appeared therefore to be Jaeger's diplococcus. A film prepared from one of the larger colonies noted on the original nasgar plate showed Gram-negative bacilli mixed with very long Gram-negative curved leptothrix forms. No change was produced by this organism in glucose, lactose, saccharose, or mannite; but acidity was produced on litmus glucose ascitic agar. On subculture on glucose ascitic agar a growth was obtained, a single colony of which gave Gram-negative bacilli which were not segmenting. On further subculture in maltose ascitic agar films now showed Gram-negative "coccating" bacilli mixed with Gram-negative diplococci indistinguishable in appearance from meningococci. Owing to an oversight these cocci were not tested in any way.

One strain of Gram-negative bacillus isolated was undoubtedly the meningobacillus previously described.

We have said that in the case of animal 14, the injection of fresh filtered cerebrospinal fluid produced a continued fever, lasting

many weeks, and that no organisms could be found in an unfiltered sample of the same specimen of fluid whether this sample was incubated or not. We also noted that while no organisms could be found in the fresh fever-producing filtered fluid—which at the time of injection was perfectly clear—the same fluid from which the inoculum was taken showed after incubation the presence of meningobacilli, and of organisms which appeared to be meningococci. In order to determine if incubation had any effect on the infectivity of the filtrate, animal 10 was injected with ten centimetres of the filtrate forty-eight hours after incubation. In spite of the fact that in animal 14 injection of clear fresh filtrate, in which no visible organisms could be demonstrated, produced a continued fever lasting many weeks, the injection of a sample of the same filtrate, now turbid from the number of organisms present, produced in animal 10 no fever during the period of observation of twenty days. The meningobacillus in late culture, the predominant organism present, appears from this experiment, therefore, to be as innocuous—when injected intraperitoneally—as the meningococcus appeared to be in the experiments already quoted.

In order, however, to determine if the absence of fever reaction was merely the result of injection of too small a dose, a fresh animal was injected with a massive dose of an emulsion of meningobacilli, isolated from the cerebrospinal fluid of another case of the disease. After observation of this animal for forty-one days after injection (less seven days owing to illness of the attendant) no fever or other systemic disturbance was noted. Later in the year two additional monkeys were injected hypodermically with massive doses—six agar slopes in each case—of the meningobacillus, and within the short limits of observation in these two animals (eight days) no rise of temperature was observed. In one case the meningobacillus had been recovered from monkey 6, which had died after an injection of blood from an acute case of the disease, and an opportunity for increase of virulence of the organism had therefore been allowed.

Taken together these four experiments certainly suggest that whether injected subcutaneously or intraperitoneally, the meningobacillus in late cultures is as harmless as the meningococcus of Weichselbaum.

Taken as a whole the conclusion which it appears to be reasonable to draw from these preliminary inoculation experiments is that the infectivity to monkeys of cerebrospinal fluid from acute cases of epidemic cerebrospinal fluid is in no way dependent on

the presence of meningococci or meningobacilli. On the contrary, the experiments appear to indicate the presence in the cerebrospinal fluid of a minute organism (capable of passage through Chamberland F filters) which is highly infective, and which is possibly the precursor of the meningococcus of Weichselbaum and the meningobacillus we have described.

Beyond this we are not, from the observations we have hitherto recorded, entitled to go.

CONCLUSIONS.

(1) The theory that the meningococcus of Weichselbaum is itself the primary infective agent in the disease epidemic cerebrospinal fever is not warranted by the evidence at present available.

(2) On the contrary, the experimental evidence here recorded distinctly suggests that the meningococcus is not itself the primary cause of the disease.

(3) The bacteriological observations here recorded appear to justify further research into the biological relationship of the meningococcus to the at present unknown primary infective agent.

(4) The fresh filtrate of fresh cerebrospinal fluid from acute cases of the disease was in two cases found to be highly pathogenic, and it is therefore possible that the true causal agent of the disease may prove to be a filtrable virus.

(5) Incubation of a filtrate, infective in the fresh condition, appears to destroy its infectivity, notwithstanding the fact that it may be after incubation crowded with living organisms which cannot reasonably be held to be contaminations.

(6) Late cultures of the meningobacillus appear to be as innocuous—as regards reproduction of the disease—as the meningococcus, when injected intraperitoneally.

(7) The meningobacillus and the meningococcus appear in some respects to be closely related

(8) For purposes of routine search for the meningococcus, and of estimation of the true bacterial content of cerebrospinal fluid in this disease, this fluid should be incubated before inoculation of solid media, in parallel with the ordinary method.

(9) Search for the presence of a filtrable virus, and examination of the question of the latter being the ancestor of pleomorphic descendants, should be carried on in conjunction with experimental inoculation of suitable laboratory animals, such as monkeys.

(10) Jaeger's organism appears, as he originally claimed, to be possessed of both Gram-positive and Gram-negative phases.

INFLUENCE OF RESULTS OBTAINED ON EPIDEMIOLOGICAL CONTROL OF THE DISEASE.

(1) The search for, and isolation of, carriers of the meningococcus should be rigorously carried on as heretofore, because although the meningococcus appears to be a harmless organism as regards reproduction of the disease its presence is nevertheless an invaluable danger-signal that the true infective agent is, or has been, present.

(2) Since the meningococcus is apparently not itself the cause of the disease it would seem to be unnecessary to attempt its destruction in the nasopharynx by sprays, meningococcal vaccines, implantation of pneumococcal emulsions, etc.

(3) Research to determine the true infective agent, whether biologically related to the meningococcus or not, is imperatively demanded, attention being specially directed to filtrable organisms in the nasopharynx, cerebrospinal fluid and blood of acute cases.

(4) If the infectivity of such filtrates be confirmed by future experiment, an attempt should be made to provide an efficient antiserum by the use of the filtrate as antigen.

(5) The theory that the meningococcus represents a late stage in the life-history of the primary infective agent deserves further study, not only on account of more obvious considerations, but also in view of its possible bearing on the problems presented by such phenomena as the curve of the epidemic.

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THE BACTERIA OF GANGRENOUS WOUNDS.

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The cases which provided the material for this investigation were selected from those undergoing treatment at the Third Northern General Hospital. The injuries were of a severe nature and in nearly all the cases there was evidence of the presence of necrotic or gangrenous tissue in the wound. Comparatively few, however, presented the clinical features of emphysematous gangrene.

Methods Employed.

The material used for examination consisted of fragments of necrotic tissue or of the discharges from the deeper parts of the wound. In some cases a piece of tissue was removed during an operation, in others swabbings were taken. Care was taken to avoid, as far as it was possible, contamination from surface organisms. In some cases a complete bacteriological examination was made, in others attention was devoted to the anaerobic micro-organisms alone.

The procedure usually adopted was as follows: (1) Films were prepared and stained by Gram's method. Additional films were in several cases stained with Leishman's stain, with Loeffler's methylene blue and by other methods. Attention was directed to the cells and to the appearance and numbers of bacteria present in the discharge.

(2) *Methods for the Isolation of Aerobic Organisms.*—Blood agar plates were inoculated and examined after incubation for periods of twenty-four and forty-eight hours. Subcultures were made from the resulting colonies and the different varieties of bacteria were identified by the usual routine methods. In a few cases plates poured with MacConkey's neutral red lactose bile salt agar were employed, in addition to the blood agar plates.

Methods for the Isolation and Identification of Anaerobic Organisms.

A tube containing about five cubic centimetres of broth was heavily inoculated with the material to be examined. In some cases a small piece of necrotic tissue was placed bodily into the tube, in others the material present on one or two swabs was thoroughly emulsified in the broth. In place of broth the following medium was employed on several occasions.

Egg Broth.—The white and yolk of one egg were thoroughly beaten up by vigorous shaking in a stout glass bottle containing a liberal supply of glass beads. Three hundred cubic centimetres of distilled water were then added and the mixture was thoroughly shaken. The bottle containing the mixture was then placed in a water bath which was slowly brought to the boil. This temperature was maintained for half an hour. During the whole period of heating the bottle was constantly and violently shaken. The result was a loose porridge-like mass consisting of finely divided particles of egg suspended in fluid. The medium was distributed in quantities of fifty to one hundred cubic centimetres in wide-mouth bottles which were plugged and sterilized in the autoclave.

"Egg broth" prepared in this way proved to be very useful as a culture medium for the growth of anaerobic micro-organisms. It is particularly useful for the growth of *Bacillus œdematis maligni.*

This egg broth or ordinary nutrient broth, after liberal inoculation, was heated for half an hour at a temperature of 80° C. It was then incubated in a Bulloch's chamber at 37° C. for periods which varied from two to twenty days. After this preliminary incubation—

(1) Films were prepared, stained and examined.

(2) Guinea-pigs were inoculated subcutaneously with one or two cubic centimetres of the broth.

(3) Agar, blood agar, or glucose agar plates were prepared, inoculated from the broth, placed in a Bulloch's chamber and incubated for a period of three to seven days.

It was found that glucose agar was the most suitable medium for these anaerobic plate cultures. Subcultures from the resulting colonies were made on Dorset's egg medium which proved admirably adapted for the needs of *B. aerogenes capsulatus* and *B. œdematis maligni.* It is probably better to subculture tetanus on glucose agar. The cultural characteristics of the various strains of anaerobic bacteria were examined on various culture media.

The examination of the aerobic organisms provided results of little or no interest and was not undertaken in every case.

Short Account of Cases.

Case 1.—Corporal E. C. E., aged 27, shrapnel wound of the back. Patient was wounded in the back by a fragment of a shell on September 14. A field dressing was applied, after which he lay for three days in a stable without further attention. At Boulogne fragments of shell were extracted from the wound. He was transferred to England, and on September 25 he was admitted to the Third Northern General Hospital, Sheffield.

Condition on Admission.—Patient presented a large and deep lacerated wound of the left lumbar muscles in the floor of which the lamina and transverse process of the fourth lumbar vertebra were exposed. The wound was in a very unhealthy condition, with its walls covered with a greyish-coloured slough. The discharge from the wound was scanty and foul-smelling. The tissues round the wound were inflamed and œdematous. Three days after admission patient developed tetanus, the symptoms of which continued with varying severity from September 28 to October 12. Antitetanic serum was injected subcutaneously at intervals; about 20,000 U.S. units in all being given.

Patient was convalescent and discharged from hospital on November 11.

Bacteriological Examination.—Films prepared from the discharge showed numerous polymorphonuclear leucocytes and a few large mononuclear cells of the endothelial type. There were numerous red blood corpuscles and a few small round cells. Cells were occasionally found which showed a small round nucleus and a definitely basophilic cytoplasm. The only micro-organism found in the films was a small Gram-positive diplococcus which was present in great numbers. Active phagocytosis had occurred and many of the leucocytes contained enormous numbers of these cocci.

Aerobic cultures were not made in this case.

Anaerobic cultures: A tube of ordinary broth was liberally inoculated with the discharge, heated for twenty minutes at 80° C. and incubated under anaerobic conditions for two days. The broth was then found to contain a large number of large, slender, actively motile bacilli. Some of these contained oval spores situated near one pole of the bacillus. These bacilli were Gram-negative. There were also a few Gram-positive short stout rods occurring singly

and in pairs. A prolonged search revealed a few bacilli with round absolutely terminal spores.

Two guinea-pigs were given a subcutaneous inoculation of one cubic centimetre of this broth. Both died within twenty-four hours. The condition was that of emphysematous gangrene, there was extensive œdema, the subcutaneous tissues being infiltrated with putrid blood-stained fluid. There was but slight gas formation. Agar plates smeared with fresh blood were inoculated from the broth and incubated for three days under anaerobic conditions. From the resulting colonies pure cultures were obtained of *B. œdematis maligni* and of *B. aerogenes capsulatus.* No tetanus colonies developed. The original broth culture was incubated under anaerobic conditions for another eight days. Subcutaneous inoculations of one cubic centimetre of the broth were made into four guinea-pigs. All these animals became very ill during the first twenty-four hours with considerable œdema at the site of inoculation. One died within the first twenty-four hours, but the other three had completely recovered within forty-eight hours. The three animals were kept under observation for some months but developed no signs of tetanus.

The case was clinically one of tetanus. The tetanus bacillus was not isolated and its presence was not demonstrated in any satisfactory way. The presence of a few bacilli in films which show a morphological resemblance to tetanus bacilli is, in our opinion, not sufficient to establish a diagnosis from a bacteriological standpoint. Exactly similar forms are seen in pure cultures of the bacillus of malignant œdema and *B. aerogenes capsulatus.*

The micro-organisms present in this case were a Gram-positive diplococcus, *B. œdematis maligni* and *B. aerogenes capsulatus.*

Case 2.—Private A. L., aged 33, shrapnel wound of the left upper arm. The patient was wounded on October 26, and admitted to the Third Northern General Hospital, Sheffield, on November 1.

Condition on Admission.—There is a small lacerated wound on the posterior aspect of the left upper arm. The whole of the arm is œdematous and swollen, and the tissues surrounding the sloughing and exceedingly septic wound are puffy, of a mottled appearance, and crepitate on applying firm pressure with the finger. The general condition of the patient is bad. November 2, 2,000 U.S. units antitetanic serum injected subcutaneously. The wound was opened up, and over a pint of thin pus burst out with great force from the deeper tissues; the fluid was frothy, very foul smelling and dark in colour. The patient rapidly became worse and died on November 5.

Bacteriological Examination.—Films from the discharge showed that the cells had been almost entirely disintegrated, the remains of polymorphonuclear leucocytes could be just recognized. The film showed large numbers of a small Gram-negative bacillus, which had every appearance of being *Bacillus coli.* Gram-positive diplococci were present in less number. There were fairly numerous short stout rods, with square cut ends, apparently encapsulated, occurring singly and in pairs. These forms were Gram-positive. Other forms, somewhat longer, occurred which were Gram-negative but showed an extensive and characteristic Gram-positive granulation. Both these are forms in which the *B. aerogenes capsulatus* occurs. There were also fairly numerous Gram-negative filamentous forms. In some the appearance was that of a continuous fibril, in others that of a chain of long slender bacilli. Some of these bacilli showed oval almost terminal spores.

Aerobic cultures: Blood agar and MacConkey's neutral red bile salt lactose agar were employed. From the plates were isolated a streptococcus which grew in fine translucent colonies and appeared in films from blood agar cultures in the form of short chains of four and six members. There was also isolated a strain of *B. coli* fermenting cane sugar, glucose, lactose, mannite and dulcite with production of acid and gas, having no action on adonite and inulin, producing indol, and clotting milk with the production of an acid reaction.

Anaerobic cultures: Ordinary beef broth was heavily inoculated with the discharge, heated for twenty minutes at 80° C. and incubated under anaerobic conditions for two days. Films were made from the broth which was found to contain numerous short rods which were recognized as *B. aerogenes capsulatus* and a very few chains of slender Gram-negative bacilli. Two guinea-pigs were inoculated subcutaneously with one cubic centimetre of this broth culture; both died within twenty-four hours with well-marked emphysema and œdema. From the broth glucose agar plates were inoculated. These plates together with the original broth culture were placed in a Bulloch's chamber and returned to the incubator. After four days' incubation the plates were found to be covered with colonies of *B. aerogenes capsulatus* in pure culture. Subcultures were made on Dorset's egg medium. At the same time films were made from the original broth which had now been incubated in all for a period of six days. The appearance of the film differed distinctly from that of the film made from the same broth four days earlier. The short forms of the *B. aerogenes*

capsulatus were still numerous, but there had been a marked increase of the long slender filamentous forms. Three plates were accordingly poured, inoculated from the original broth and incubated for four days. At the end of this time it was found that the colonies were nearly all those of the bacillus of malignant œdema. There were in addition a few colonies of *B. aerogenes capsulatus*.

Summary.—From this case were isolated a streptococcus, a common variety of *B. coli*, the *B. aerogenes capsulatus* and the *B. œdematis maligni*. From the clinical standpoint the case was a very typical example of emphysematous gangrene, the gas formation in the tissues being a marked feature. In this case, in which much gas was developed in the tissues, films made from the discharge showed large numbers of *B. aerogenes capsulatus*.

Case 3.—Private A. J., aged 23, shrapnel wounds of the left arm—amputation. Admitted to the Third Northern General Hospital on November 6, 1914. Injury sustained on October 31.

Condition on Admission.—Patient has two large lacerated wounds on the posterior and inner aspects of the left upper arm, with extensive and deep laceration of the underlying triceps muscle. A large drainage tube has been inserted into each of the wounds. Both the wounds are covered with greyish coloured sloughs, and bathed in thin foul smelling pus. Sensation is lost over the ulnar side of hand, on both aspects, with an apparently complete paralysis of all the muscles supplied by the ulnar nerve.

Gangrene of the limb followed ligature of the brachial artery for secondary hæmorrhage, and necessitated amputation on November 9. Patient was discharged to convalescent hospital on December 1.

Bacteriological Examination.—The material for this examination was taken from the arm after it had been amputated. The arm was swollen and œdematous; the skin was discoloured with mottled patches of purple and greenish yellow tint. No gas formation was detected. On dissecting the arm it was found that the muscles had a deep brownish-red colour and that the intermuscular planes were infiltrated with a foul-smelling greenish pus. The surface was seared with a hot iron and the material for examination was removed from the deep tissues close to the bone. The discharge was found to consist of blood and pus. There were numerous staphylococci and streptococci. Active phagocytosis had occurred and many of the leucocytes contained enormous numbers of cocci. The films showed a few Gram-positive short rods and a few Gram-negative slender filaments.

Aerobic cultures: From the blood agar plates were isolated *B. subtilis*, two varieties of streptococcus and *Staphylococcus aureus*.

Anaerobic cultures: A piece of necrotic tissue from the deep part of the arm was placed in a wide tube containing broth. The tube was heated for half on hour at 80° C. and incubated under anaerobic conditions. After five days the anaerobic chamber was taken down and films were made. The films showed almost a pure culture of *B. œdematis maligni*. The *B. aerogenes capsulatus* was present in smaller numbers. Glucose agar plates were inoculated and incubated under anaerobic conditions for three days. The majority of the colonies proved to be those of *B. œdematis maligni*, but there were a few colonies of *B. aerogenes capsulatus*. Two guinea-pigs received a subcutaneous inoculation of one cubic centimetre of this five-day-old broth culture. Both showed signs of illness after twelve hours with slight swelling at the site of inoculation. Both animals rapidly recovered and remained well.

Summary.—From this case were isolated two varieties of streptococcus, *Staphylococcus aureus*, *B. subtilis*, *B. œdematis maligni* and *B. aerogenes capsulatus*. The œdema and necrosis of the tissues were exceptionally severe. No gas formation was observed. *B. aerogenes capsulatus* and *B. œdematis maligni* were seen in films prepared from the discharge.

Case 4.—Private J. B., aged 30, bullet wound of the penis and scrotum; dislocation of the penis. Wounded October 28, 1914. Put on field dressing. Lay in trench all night. Walked following morning at daybreak to dressing-station. Sent to Bethune same day. At Bethune Thursday to Monday, dressed twice. Antitetanic serum given while at Bethune; Bethune to Boulogne; two days at Boulogne; was given chloroform, and dressed once, but was not dressed again until about three days later, when he was admitted to the Third Northern General Hospital on November 6.

Condition on Admission.—The bullet appears to have struck the patient on the right side of root of penis, at its junction with tissues covering right groin, to have then traversed the substance of the penis, cutting cleanly across the corpora cavernosa, and dislocating the whole body of the organ from the penile skin. November 7: antitetanic serum 2,000 U.S. units was administered. December 9: the wounds are now covered with healthy granulations, and the patient was discharged to a convalescent home on February 5.

Bacteriological Examination.—Films prepared from the discharge

showed numerous pus cells. There were a few Gram-positive diplococci and a few short chains of streptococci. Agar plates smeared with fresh blood were inoculated; the microorganisms isolated were a streptococcus, *Staphylococcus albus*, and *B. subtilis*. No anaerobic bacteria were found.

Case 5.—Bombardier E. J., aged 28, R.G.A., shell wound of the right arm. Patient had the right forearm blown off by a shell on October 26. The stump was cleaned, trimmed up, and stitched at a clearing hospital the same night, and antitetanic serum administered. He was sent to Boulogne and thence to England; admitted to the Third Northern General Hospital on November 1.

Condition on Admission.—An amputation has been performed through the lower third of the right upper arm. The stitches have been removed, and there is cellulitis of the stump. The flaps are gaping and wound discharging freely. The wound cleaned up rapidly, was skin-grafted on November 13, and patient was sent to convalescent hospital on November 18.

Bacteriological Examination.—Films made from the discharge obtained from this case showed numerous pus cells, many Gram-positive diplococci, many Gram-negative bacilli of the *B. coli* type, and a few staphylococci.

Aerobic Cultures: Blood-agar plates showed numerous colonies of *Staphylococcus aureus*, a few colonies of a streptococcus growing in short chains and a *B. coli* which gave the following reactions: It fermented glucose, lactose, mannite, and dulcite with production of acid and gas. It did not ferment cane sugar, adonite, and inulin. It formed indol, and clotted milk with production of acid.

Anaerobic Cultures: Broth was heavily inoculated with the discharge, heated for half an hour at 80° C., and incubated for three days. Films made from this broth showed the bacillus of malignant œdema and a small actively motile Gram-negative bacillus. Glucose agar plates were inoculated and incubated for three days. Two types of colony were observed: (1) The colonies of the bacillus of malignant œdema; (2) large, clear, round colonies possessing no distinctive characteristics. Films from these colonies showed a small Gram-negative bacillus with rounded ends.

Further tests showed that this was an aerobic organism. It had the following characteristics: Agar slope: Profuse whitish moist growth. Dorset's egg medium: Profuse whitish growth, slow liquefaction and bluish-black discoloration of the medium; odour of hydrogen sulphide. Inspissated blood serum: Profuse moist growth with liquefaction of medium. Broth: Turbidity

produced, with sweet but offensive odour. Indol was not produced. Gelatine: Liquefaction of medium. Litmus milk: A well-marked alkaline reaction was developed. Later the colour was destroyed, the medium became clear and translucent, and there was a considerable flocculent deposit. Reactions of bacillus on peptone water sugars: Glucose and lactose were fermented with acid production, cane sugar, mannite, dulcite, sorbite, and raffinose were not fermented, but after about five days a definite alkaline reaction developed. Inoculation experiments: Two guinea-pigs received a subcutaneous inoculation of one cubic centimetre of the broth at 6 p.m. on November 25. Both were found dead the next morning. The post-mortem examination showed well-marked œdema at the site of inoculation. The fluid obtained was blood-stained, and contained large numbers of a Gram-negative bacillus. Plates were prepared and inoculated, and a pure culture of the bacillus was obtained. Two guinea-pigs were inoculated on November 30 with one cubic centimetre each from another broth culture of this bacillus. No local or general symptoms were observed to follow inoculation, but one of the animals died on December 15 and the other December 19. There was no evidence of inflammation at the site of inoculation, the internal organs showed no pathological change, and the heart blood was sterile. This bacillus had well-marked capacity for the digestion of protein, and was possessed when freshly isolated of considerable virulence for guinea-pigs. It was evidently a putrefactive organism, and probably a member of the proteus group.

Summary.—Aerobic Organisms: *Staphylococcus aureus*, a streptococcus, *Bacillus coli communis*, a micro-organism belonging to the proteus group.

Anaerobic Organisms: *Bacillus œdematis maligni.*

Case 6.—S. B., aged 32; shell wounds of the legs; tetanus. Wounded on October 5 in both legs. Two days later several fragments of shell were removed at a field hospital from the anterior aspect of the upper third of the left leg, and another fragment, which had inflicted a flesh wound, was extracted from the antero-external aspect of middle third of the right leg. Patient was transferred to England on October 18, and admitted to the First Western General Hospital at Liverpool on October 20; was there five weeks, and then sent to Sheffield on furlough; was admitted to Third Northern General Hospital on November 20 after ten days' furlough suffering from tetanus, the symptoms of which began to develop while on furlough. On admission, there was a small

septic sinus on the anterior aspect of the right leg just below the knee. The other wounds were healed. Patient has frequent spasms of the muscles of back of neck, back and lower limbs, and complains of pains down the legs. Jaw spasm is present, but not in a marked degree, and patient is able to swallow; 4,000 U.S. units antitetanic serum were administered, and repeated on the following day. Patient's symptoms gradually passed off, and he was discharged apparently convalescent at the end of three weeks in hospital.

Bacteriological Examination.—Films showed cell debris and a few leucocytes. No micro-organisms of any kind were found; no aerobic cultures were made. A tube of broth was freely inoculated (November 25), heated for half an hour at 80° C., and incubated under anaerobic conditions for six days. On December 1 films were made which showed the presence of *Bacillus œdematis maligni.* The broth was returned to the anaerobic chamber and incubated for a further period of eleven days (seventeen days in all). On December 11 the films showed a large number of forms resembling tetanus bacilli. The bacilli of malignant œdema were also plentiful. On the same day (December 11) two guinea-pigs were inoculated. Each animal received one cubic centimetre of the broth culture subcutaneously on the left side of the thorax. On December 13 both animals showed a spastic condition of the left upper limb. The spasms spread to the other limbs. One animal died in the night between December 13 and December 14. The second animal died on December 14. Plates were prepared on December 11 and inoculated from the broth. The resulting colonies were all those of malignant œdema. The broth was returned to the anaerobic chamber and incubated for a third period of six days (twenty-three days in all). On December 17 a third set of films were made. Almost all the bacteria seen in the film appeared to be tetanus bacilli. There were a few malignant œdema forms. Plate cultures were again made, and again the only result was a large number of colonies of *B. œdematis maligni.* Subsequently repeated attempts to obtain a pure culture of the tetanus bacillus from this case ended in failure.

Summary.—The case was one of tetanus of a chronic and somewhat mild type. No examination of the aerobic bacteria was undertaken. The *Bacillus œdematis maligni* was isolated in pure culture. Impure cultures of tetanus were obtained, the inoculation of which produced typical symptoms and death in guinea-pigs. The prolonged period of incubation required for the development of the tetanus bacillus is of some interest. Films made from the

broth after six days' incubation did not show the tetanus bacillus. After seventeen days numerous tetanus bacilli could be demonstrated; after twenty-three days the tetanus bacillus was present in almost pure culture.

Case 7.—Private W. W., aged 24; gunshot wound of the back. Wounded December 18; field dressing was applied at once, and wound was dressed three hours later; was in Boulogne and Havre for one night each, and the wound was dressed at both places. Admitted December 22 to Third Northern General Hospital.

Condition on Admission.—Patient presents a wound of the back, tunnelling the erector spinæ muscles and subcutaneous tissues in lower dorsal region, with a drainage tube of large size along the tract. The wound of entry is to the right of the spinal column, and smaller than the large wound of exit. Both intensely septic, foul smelling, covered with greyish sloughs, pouring with pus. Cellulitis of surrounding tissues, but not crepitating on pressure. December 22: 2,000 units of antitetanic serum given subcutaneously. December 26: wounds have cleaned up rapidly, and are now granulating and healing rapidly.

Bacteriological Examination.—Films made from the discharge showed numerous disintegrated polymorphonuclear leucocytes. There were a few rather large cocci, Gram-positive, arranged in pairs and flattened at the apposed surfaces.

Aerobic Cultures: From blood agar plates were isolated *Staphylococcus aureus*, *S. albus*, a streptococcus and a micro-organism belonging to the *Micrococcus tetragenus* group.

Anaerobic Cultures: "Egg broth" was freely inoculated, heated for half an hour at 80° C. and incubated for three days. Films then showed a pure culture of *B. œdematis maligni.* Blood agar plates were inoculated from this medium and a pure culture of *B. œdematis maligni* was obtained.

Case 8.—Private G. S., aged 40. Bullet wound of the left hip. Wound sustained December 18, about 6 p.m. Patient rested during the night in dug-out, and reached a dressing-station between 6 and 7 a.m. December 19, where the first field-dressing was applied. Dressed in hospital train and again on boat and on hospital train in England. Admitted to Third Northern General Hospital December 22.

Condition on Admission.—Entrance wound on the left side just below the iliac crest. Exit wound superficial to the great trochanter. Both lacerated, septic and sloughing. Cellulitis surrounding the wounds. Discharge is scanty and serous rather than purulent in

character. Both wounds are drained with rubber tubing of large size. Two thousand U.S. units antitetanic serum were given on January 1. Patient had had no previous injection of antitetanic serum. January 3: wounds cleaner and now suppurating freely, general condition is much improved. January 7: wounds now granulating and fairly healthy looking. Patient was discharged convalescent.

Bacteriological Examination.—The discharge showed numerous pus cells. A large encapsulated bacillus was present in large numbers. This was thought to be the *B. aerogenes capsulatus*. There were a few bacilli with rounded ends, and showing oval and almost terminal spores. These were thought to be the *B. œdematis maligni*. There were also numerous streptococci and Gram-positive diplococci.

Aerobic Cultures: From blood agar plates the *S. aureus* and a streptococcus were isolated.

Anaerobic Cultures: Egg broth was freely inoculated, heated for half an hour at 80° C. and incubated for three days. The forms seen in films were those of *B. œdematis maligni* and of *B. aerogenes capsulatus*. Plates were prepared and both micro-organisms were obtained in pure culture.

Case 9.—Private L. S., aged 33. Bullet wound of the back. Wound sustained December 18. Patient says that he was given antitetanic serum three hours after being wounded, when at the dressing-station. Wound was not dressed after that for three days, when the dressing was changed on the hospital ship. Admitted to the Third Northern General Hospital December 22.

Condition on Admission.—Patient presents an extensive but apparently superficial wound of the left side of the back in the upper thoracic region. Both wounds are gaping, covered with sloughing, purulent material and foul smelling. The discharge is copious and purulent. The extensive œdema surrounding the wound is not crepitating. Two large fragments of bullet casing were extracted from the bullet track at first dressing after admission. The wound cleaned up and healed rapidly, and patient was discharged to convalescent hospital on January 10.

Bacteriological Examination.—Films from the discharge showed numerous pus cells. There were numerous encapsulated diplococci, occurring in chains of two, three, and four pairs. There was a smaller variety of Gram-positive diplococcus and a large coccus occurring in groups of four. There were also fairly numerous Gram-positive encapsulated bacilli which were considered to be *B aerogenes capsulatus.*

Aerobic Cultures: From blood agar plates were isolated *Staphylococcus aureus*, a streptococcus and the *Streptococcus mucosus*.

Anaerobic Cultures: "Egg broth" was liberally inoculated with the discharge, heated for half an hour at 80° C. and incubated under anaerobic conditions for four days. Films made at the end of this time showed *B. œdematis maligni* and the *B. aerogenes capsulatus*. A few bacilli in the film were identical in appearance with the tetanus bacillus. Two guinea-pigs were inoculated (one cubic centimetre each subcutaneously) with this mixed culture on December 30. Both died of typical gas gangrene on January 1. From anaerobic plate cultures *B. aerogenes capsulatus* and *B. œdematis maligni* were isolated in pure culture.

Case 10.—Private W. J. S., aged 21. Shrapnel bullet wound of the right side. Patient was wounded on December 19. He crawled into a ditch, where he lay from 4.30 till 12 at night. Dressed the following morning, and sent straight through on train and boat, arriving at Third Northern General Hospital on December 23.

Condition on Admission.—Patient had a deep lacerated wound above the right iliac crest, very septic, with a thin, foul-smelling discharge from the drainage-tube which occupied the wound, the edges of which were covered with greyish sloughing tissue. The wound extended deeply, and bits of smashed-up iliac bone could be felt in it. An anæsthetic was administered, and the wound was opened up. Large fragments of the iliac bone with bits of clothing embedded between them were removed. The cæcum was exposed in the deeper and inner portions of the wound, but the bowel appeared to be intact. Two thousand U.S. units of antitetanic serum were administered and repeated on January 1. Large drainage-tubes were inserted. The usual local treatment was carried out and on February 21 the patient was discharged to convalescent hospital, with wounds clean, granulating and nearly healed.

Bacteriological Examination.—The films made from this discharge showed numerous polymorphonuclear leucocytes, the majority of which were actively phagocytic. The micro-organisms seen in the films were streptococci, Gram-positive diplococci, staphylococci and small Gram-negative bacilli with rounded ends.

Aerobic Cultures: From blood agar plates were isolated *S. aureus*, a streptococcus and a *B. coli* which had the following characteristics. It was a short Gram-negative motile bacillus, fermenting glucose, lactose, mannite and dulcite, with production of acid and gas, having no action on cane sugar, adonite and inulin. It formed indol and clotted milk.

Anaerobic Cultures: "Egg-broth" was freely inoculated, heated for half an hour at 80° C. and incubated under anaerobic conditions for four days. The films were then made and showed not only *B. aerogenes capsulatus* and *B. œdematis maligni*, but also numerous slender rods with large round absolutely terminal spores. These were considered to be tetanus bacilli. About one cubic centimetre of the mixed culture was injected beneath the skin of a guinea-pig on December 30. On January 1 the fore limb on the left side showed marked extensor spasm. Spasms spread to the other limbs and the animal died with typical tetanic symptoms on January 2. At the post-mortem examination a slough was found at the site of inoculation. Films were made which showed numerous cocci and a few bacillary forms which were considered to be the bacillus of malignant œdema. Anaerobic cultures were prepared from this material with the result that a pure culture of the *B. œdematis maligni* was obtained. From the original "egg-broth" glucose agar and blood agar plates were inoculated and incubated under anaerobic conditions. The plates showed colonies of *B. œdematis maligni*. There were no tetanus colonies. Repeated attempts to isolate a pure culture of tetanus failed. On January 9 a second specimen was obtained from the patient's wound. Egg-broth was freely inoculated, heated for fifteen minutes at 80° C., and incubated for five days under anaerobic conditions. The films, which were then made, showed *B. aerogenes capsulatus* and *B. œdematis maligni*. A portion of the culture was used to inoculate two guinea-pigs, both of which died of tetanus four days later. Repeated attempts to obtain a pure culture of tetanus ended in failure.

Summary.—Aerobic organisms isolated were *Staphylococcus aureus*, a streptococcus and *B. coli communis*. Anaerobic organisms isolated were *B. aerogenes capsulatus* and *B. œdematis maligni*. Although the tetanus bacillus was not obtained in pure culture, its presence was proved by the result of the inoculation experiments on guinea-pigs. The patient developed no symptoms of tetanus. Two thousand units of antitetanic serum had been administered on admission (December 23), and a further two thousand units were given on January 1, the day on which definite evidence of tetanus was detected in the first of the inoculated guinea-pigs.

Case 11.—Private W. B., aged 28, shell wounds of the right arm. The patient was wounded on February 4, 1915, when a piece of the shell entered the outer aspect of the right arm above the elbow. The fragment traversed the arm and came out on the

back of the arm at a slightly higher level. There was very little bleeding. A stretcher-bearer applied a first field dressing, and patient got back to a field ambulance dressing station that night, where iodine was applied to the wound, fresh dressings put on and antitetanic serum injected. Next day the patient was sent to Boulogne, and thence by ship and train to Sheffield, arriving there on the 6th, fifty-two hours after the wound was sustained. Patient states that the day after receiving the wound the arm was very painful, swollen and hot, and when dressed at Boulogne the wound was very septic and discharged pus freely.

Condition on Admission.—Patient presents a lacerated and septic tract, which traverses the triceps muscle about the middle of the right upper arm; portions of lacerated muscle protrude from the more extensive exit wound on the posterior aspect, and a large drainage tube has been inserted through the wound. The wounds are discharging freely, very septic and foul smelling, and there is considerable reaction of the surrounding tissues, which do not crepitate on applying pressure with the finger. No fracture or nerve lesions present. February 15: both wounds now healthy and healing.

Bacteriological Examination.—Films showed red blood corpuscles and numerous pus cells, many of which contained cocci. Gram-positive diplococci were numerous. There were a few staphylococci. Anaerobic cultures only were made. A flask containing one hundred cubic centimetres of beef broth was liberally inoculated and incubated (aerobically) for twenty-four hours. It was then heated for half an hour at 80° C. and incubated under anaerobic conditions for four days. The films which were then made showed *B. aerogenes capsulatus* but no other micro-organism. Glucose agar plates yielded a pure culture of *B. aerogenes capsulatus.* The original broth culture was returned to the anaerobic chamber and incubated for a further period of four days. The films made after the second period of incubation, that is to say after eight days, showed numerous bacilli which were recognized as *B. œdematis maligni*, as well as a lesser number of *B. aerogenes capsulatus.* Glucose agar plates were again prepared and inoculated, and on this occasion colonies of *B. aerogenes capsulatus* and *B. œdematis maligni* were obtained.

Summary.—The examination in this case was confined to the anaerobic bacteria. Pure cultures of *B. aerogenes capsulatus* and of *B. œdematis maligni* were isolated.

Case 12.—L. B., aged 19, bomb wound of the legs. Patient was

wounded on February 4. The injury was caused by a hand bomb which was thrown into the trench from a distance of twenty-five yards. A field dressing was applied to the wounds, and patient was taken straightway to a field dressing station, where the wound was bathed and a dry dressing applied to it. Patient was then sent to Bethune, where a fomentation was substituted for the dry dressing, and antitetanic serum injected subcutaneously. Patient was admitted to the Third Northern General Hospital on February 8.

Condition on Admission.—The wound of right leg is slight merely an abrasion of the shin. On the left leg there are two lacerated and septic wounds on the outer aspect immediately above and below the knee. The extensor muscles are exposed in the base of the more extensive upper wound, and both wounds are sloughing aud unhealthy looking. February 22: wounds now clean and granulating. February 27: discharged to convalescent home.

Bacteriological Examination.—Films made from the discharge showed numerous pus cells and Gram-positive diplococci.

Aerobic Cultures: From blood agar plates pure cultures of a streptococcus and of *Staphylococcus aureus* were obtained.

Anaerobic Cultures: A flask containing "egg broth" was heated for half an hour at 80° C., and incubated under anaerobic conditions for four days. Films were then made and showed the *B. aerogenes capsualatus* in considerable numbers. Blood agar plates were inoculated and yielded a pure culture of *B. aerogenes capsulatus.* Two cubic centimetres of the egg broth were injected beneath the skin of a guinea-pig. No symptoms of any kind were produced. The "egg-broth" was now returned to the anaerobic chamber and incubated for a second period of seven days. At the expiration of this time, eleven days from the inoculation of the medium, films showed a large number of *B. œdematis maligni,* but only a few *B. aerogenes capsulatus.*

Blood agar plates were prepared and inoculated. The result was a pure culture of the *B. œdematis maligni.*

Summary.—The aerobic organisms isolated were the *S. aureus* and a streptococcus. The anaerobic organisms were the *B. aerogenes capsulatus* and the *B. œdematis maligni.*

After four days' incubation the egg broth appeared to contain a pure culture of *B. aerogenes capsulatus.* At the expiration of eleven days the predominant micro-organism was the *B. œdematis maligni.*

Case 13.—Private M., aged 22. Bullet wound of right thigh. Patient was near the reserve trenches at 7.30 a.m., on February 4, when he was struck on his right thigh, in the region of his right hand trouser pocket. The course of the bullet was diverted by his pocket knife, and it entered the antero-lateral aspect of the thigh at the junction of the upper and middle third. It went into the muscles and came out at a point about one or two inches to the outer side of the wound of entry. A first field dressing was applied, and that night patient was carried back to headquarters, where another dressing was applied (no iodine was used); an injection of serum was given. He was dressed again at 3 a.m. on the 5th. Then to Boulogne where another dressing was applied. Then by ship and train to the Third Northern General Hospital, Sheffield, arriving there sixty-four hours after being wounded.

Condition on Admission, February 8.—Patient presents two suppurating wounds on the outer aspect of the right thigh. The posterior wound (wound of exit) is the more extensive and lacerated, with sloughing muscle substance protruding from it. A large rubber drainage tube has been inserted through the bullet tract. The patient made a good recovery.

Bacteriological Examination.—Films made from the discharge showed pus cells, a few staphylococci and many Gram-positive diplococci.

Aerobic cultures: From blood agar plate were isolated, *Staphylococcus aureus, S. albus*, a streptococcus and a member of the *B. coli* group which fermented cane sugar, glucose, lactose, mannite and dulcite with production of acid and gas; did not ferment adonite and inulin; produced indol and clotted milk with formation of acid.

Anaerobic cultures: A flask containing "egg broth" was freely inoculated, heated for half an hour at 80° C. and incubated for four days under anaerobic conditions. Films were then made and showed large number of *B. aerogenes capsulatus*. Glucose agar plates were inoculated and incubated, with the result that a pure culture of *B. aerogenes capsulatus* was obtained. Two guinea-pigs which had been inoculated subcutaneously with two cubic centimetres each of the "egg broth" culture died within twenty-four hours. Well-marked emphysematous gangrene was observed at the post-mortem examination. The flask containing egg broth was returned to the anaerobic chamber and incubated for a further period of seven days (eleven days in all). Films were then examined and glucose agar plates were inoculated. The only micro-organism present was *B. aerogenes capsulatus*.

Summary.—The aerobic micro-organisms isolated from this case were *S. aureus* and *albus*, a streptococcus, a common member of the *B. coli* group. The only anaerobic organism present was the *B. aerogenes capsulatus.*

Case 14.—Private A. O'B., aged 29, shell injury of left shoulder. Wounded February 2. Lay for three days in the trenches with first aid dressing, then taken to field hospital and then to clearing hospital. Was dressed at field and clearing hospitals and was given injections of antitetanic serum; then sent on to Boulogne, and home to Sheffield.

Condition on Admission, February 9.—Very poor general condition. The tissues are œdematous, pallid and crepitate on pressure around a large septic wound on top of left shoulder, of which the drainage appears to be defective. X-rays show that a large piece of shrapnel has entered the left shoulder, broken up the great tuberosity of the left humerus, smashed the clavicle into fragments, and has lodged in the posterior triangle of neck under the trapezius muscle above the scapula. February 9: large fragment of shell extracted, and several pieces of broken-up bone and cloth removed. There is a copious discharge of stinking gaseous pus; free incisions were made, large drainage tubes inserted and 2,000 U.S. units of antitetanic serum were injected. March 5: wounds healing up rapidly under usual treatment. Patient made a good recovery.

Bacteriological Examination.—Films from the discharge showed numerous pus cells. Numerous Gram-positive diplococci were seen and a few short granular rods which were thought to be degenerated forms of *B. aerogenes capsulatus.* Anaerobic cultures only were made. Broth was freely inoculated, heated for half an hour at 80° C., and incubated for three days in an anaerobic chamber. Films showed *B. aerogenes capsulatus* only. Glucose agar plates were prepared and inoculated. The colonies were those of *B. aerogenes capsulatus* and of a small bacillus which belonged to the diphtheroid group. The broth was returned to the anaerobic chamber and incubated for a further period of five days (eight days in all). Films now showed *B. aerogenes capsulatus, B. œdematis maligni* and bacilli which were thought to be tetanus bacilli. Blood agar plates were inoculated from the broth, and incubated for four days in the anaerobic chamber. Colonies of *B. œdematis maligni* and of *B. aerogenes capsulatus* were found, but not of tetanus. A guinea-pig was inoculated on February 18, with the eight-day-old-broth. The animal died of typical gas gangrene on February 20. On February 19 a second

guinea-pig was inoculated with this broth. Swelling and gas production at the site of inoculation were observed on February 21. On February 22 the animal appeared to have completely recovered. On February 25 the guinea-pig was found dead in its cage. The rigid extension of all limbs and the stiffness of the body and neck suggested tetanus as the cause of death. Unfortunately, the animal had not been examined on the previous day. Meanwhile the original broth culture had been subjected to a third period of incubation in the anaerobic chamber. A third set of films was made on February 26, seventeen days from the date of inoculation of the broth. Films showed numerous tetanus bacilli in addition to *B. œdematis maligni* and *B. aerogenes capsulatus.* One cubic centimetre of the broth was inoculated subcutaneously into each of two guinea-pigs on February 26. Both animals showed definite signs of tetanus on March 1. One died on March 1, and the other on March 2. The cause of death was in both cases tetanus. Numerous unsuccessful attempts were made to isolate the tetanus bacillus in pure culture.

Summary. — No aerobic cultures were attempted. The *B. aerogenes capsulatus* and the *B. œdematis maligni* were isolated in pure culture. The presence of the tetanus bacillus was demonstrated by animal inoculations. This case shows the advantage of prolonged incubation. It appears that if the tetanus bacillus is present in small numbers, a considerable time must be allowed for multiplication. A further advantage lies in the fact that the prolonged period of incubation tends to diminish the virulence of *B. aerogenes capsulatus,* and inoculation experiments are less likely to be vitiated by the premature death of the guinea-pig, as the result of emphysematous gangrene. Although tetanus bacilli were demonstrated in the discharge from the wound, the patient was never observed to have any symptom of tetanus. He received antitetanic serum in France, and again after admission to the hospital in Sheffield. Gas formation was observed in the tissues of the patient in this case.

Case 15.—J. R., aged 31, shrapnel wound of the right shoulder and left leg. Patient was wounded on October 25. Admitted to the Third Northern General Hospital on November 1, suffering from a compound, comminuted fracture of lower end of left femur, and lacerated wound of right shoulder.

Condition on Admission.—Both wounds were infected and covered with sloughing debris of the damaged tissues. November 1: a large fragment of shell was removed from the inner side of the left

leg and pieces of clothing from both wounds. On November 7 patient developed tetanus. The symptoms lasted for three weeks and were relieved by intrathecal and subcutaneous injections of anti-tetanic serum. Patient recovered completely after a tedious convalescence and was discharged from hospital in April, 1915.

Bacteriological Examination. — Films showed a very few streptococci. The cells were too degenerated for recognition. No bacillary forms were found. Anaerobic cultures were not made. Broth was freely inoculated, heated for half an hour at 80° C. and incubated under anaerobic conditions for five days. Films made from the broth showed the *B. œdematis maligni* in large numbers. Blood agar plates were prepared and inoculated. The result showed numerous colonies of *B. œdematis maligni* and a few colonies of *B. aerogenes capsulatus*. By this time the patient had developed definite signs of tetanus, and every effort was made to detect tetanus bacilli in the cultures. The original broth culture was examined for a second time after ten days' incubation, and for a third time after fifteen days' incubation. Films showed no forms resembling the tetanus bacillus and inoculation experiments with guinea-pigs yielded no result. The fragments of clothing removed on November 15 were also examined. *B. œdematis maligni* and *B. aerogenes capsulatus* were isolated. Tetanus bacilli were not found.

Summary.—No anaerobic cultures were made. *B. aerogenes capsulatus* and *B. œdematis maligni* were isolated. Patient showed typical signs of tetanus. All attempts to demonstrate the presence of *B. tetani* in the wound were unsuccessful.

(*To be continued.*)

REPORT ON THE USE OF SODIUM HYPOCHLORITE PREPARED BY THE ELECTROLYSIS OF SEA WATER FOR DISINFECTING AND ANTISEPTIC PURPOSES ON H.M.H.S. "AQUITANIA."

(To the Medical Research Committee.)

BY H. D. DAKIN, D.Sc. AND H. G. CARLISLE, M.D.

(1) INTRODUCTION.

THE preparation of sodium hypochlorite by the electrolysis of salt solutions is an old process, and since Watts's initial discovery in 1859 innumerable modifications in its mode of production have been introduced, chiefly for industrial purposes. The deodorizing and germicidal properties of the hypochlorites have been known for more than a century, and it is impossible to refer in this report to many of the applications for hygienic purposes which these substances have found.

Reference may be made, however, to the well-known Hermite process for the sterilization of sewage by electrolytic hypochlorite, introduced about 1893; to the wide employment of hypochlorites for the purification of suspected potable waters, and to the many uses as disinfectant which hypochlorites have found in sanitary work. Electrolytic hypochlorite for general disinfection purposes has been successfully employed by several sanitary authorities, notably at Poplar, and installations for its production have been erected at Osborne, Netley, and other places. The extensive use with favourable results of electrolytic hypochlorite in the plague epidemic in Glasgow in 1901 may also be cited.

Having had an opportunity of observing some of the difficulties in securing good sanitary conditions on large hospital ships carrying infectious cases, it was considered probable that useful employment might be made of electrolytic hypochlorite prepared from sea-water. Lieutenant-Colonel R. H. Fuhr, D.S.O., R.A.M.C., of H.M.H.S. "Aquitania," welcomed the idea most cordially and did everything that was possible to facilitate the investigations. We are indebted also to the Cunard Company for much helpful co-operation.

In the first place it was necessary to devise an apparatus suitable for use on shipboard. This being done, the next question

was to investigate the most favourable conditions for carrying out the electrolysis, then to determine the most advantageous method of applying the product. Nothing essentially new is claimed for any of the work referred to in this report, and free use has been made of the experience of others. The object of the investigation has been rather to apply existing knowledge to the special problems of hospital ship sanitation. The advantages of a hospital ship being in possession of a simple apparatus for obtaining a practically inexhaustible supply of a powerful disinfectant at low cost is too obvious to need emphasis.

For convenience the report is divided into the following Sections:—

(1) Introduction.

(2) Description of apparatus.

(3) The operation of electrolysis.

(4) Cost of apparatus and of electrolytic hypochlorite.

(5) The optimum concentration of hypochlorite for disinfecting purposes in wards, etc.

(6) The uses of electrolytic hypochlorite in the wards, etc.

(7) Rate of decomposition of electrolytic hypochlorite on keeping.

(8) Purification of ships' drinking water by means of electrolytic hypochlorite.

(9) Surgical uses of electrolytic hypochlorite as an antiseptic.

(10) Other applications of electrolytic hypochlorite.

(11) The action of electrolytic hypochlorite on various structural materials.

(12) Summary.

(13) Report of Lieutenant-Colonel R. H. Fuhr.

(2) Description of Apparatus.

The necessary apparatus comprises an electrolytic cell, a half-scale drawing giving the necessary dimensions being attached to this report. A reversing switch capable of carrying a hundred amperes and some ordinary insulated electric cable.

The electrolyzer consists of a rectangular box made of teak or cedar securely bolted together. It may be coated internally with marine glue to protect the wood and to reduce the risk of leaking.

The interior of the box is divided into twenty or preferably twenty-five cells by means of carbon plates placed parallel to

one another. The plates situated at both ends of the box project above the level of the other plates to receive the terminals for the introduction of the currents. The terminal electrodes for convenience are made in four pieces placed side by side, while the intermediate carbons are made in three parts super-imposed vertically one upon the other. A copper plate attached to the four binding screws at each end insures an even distribution of current.

The carbon plates are separated from each other by strips of vulcanite or wood, or glass tubes, and they are kept in position by means of a "making up block" and wedges placed at one end of the tank. A grooved channel is cut along one side of the floor of the wooden tank underneath the carbon plates in order to facilitate the emptying of the contents of the tank by means of a wooden or vulcanite plug tap inserted in a hole connected with the floor of the tank.

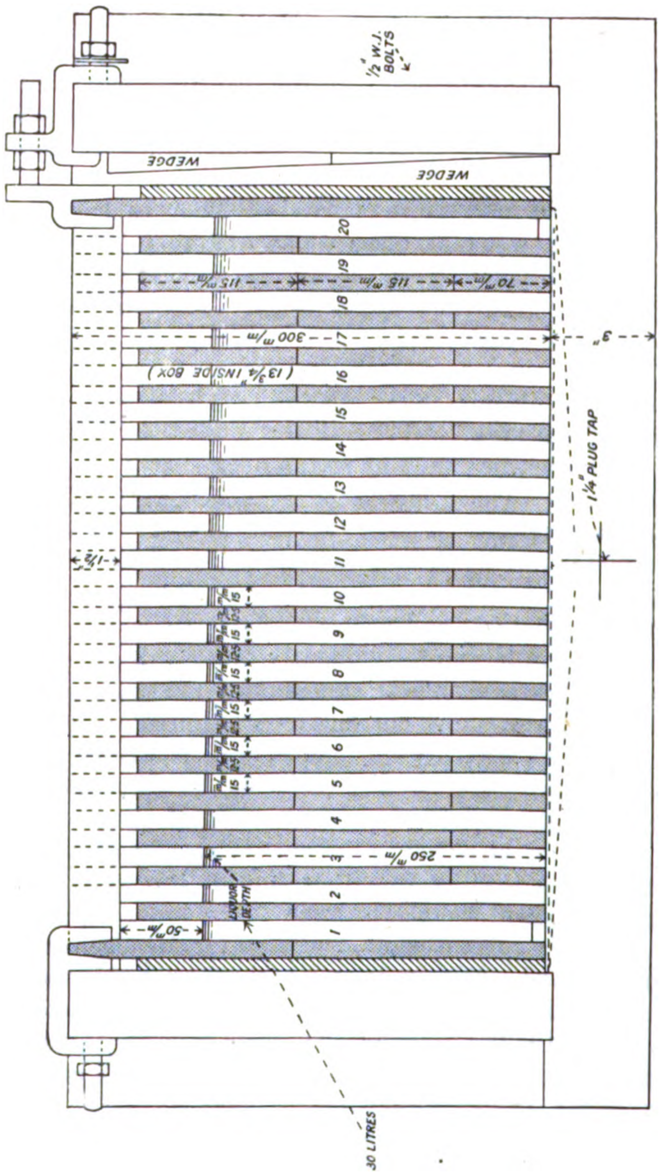
A word must be added as to the necessity of employing suitable carbon plates. These should be of Acheson graphite prepared by treating amorphous carbon in the electric furnace. Ordinary carbon plates rapidly deteriorate and cannot be used satisfactorily.

The tank should be mounted on a rubber mat or on glass or porcelain insulators, and securely fixed to a low table so that its contents can be run conveniently into a tub placed beneath it.

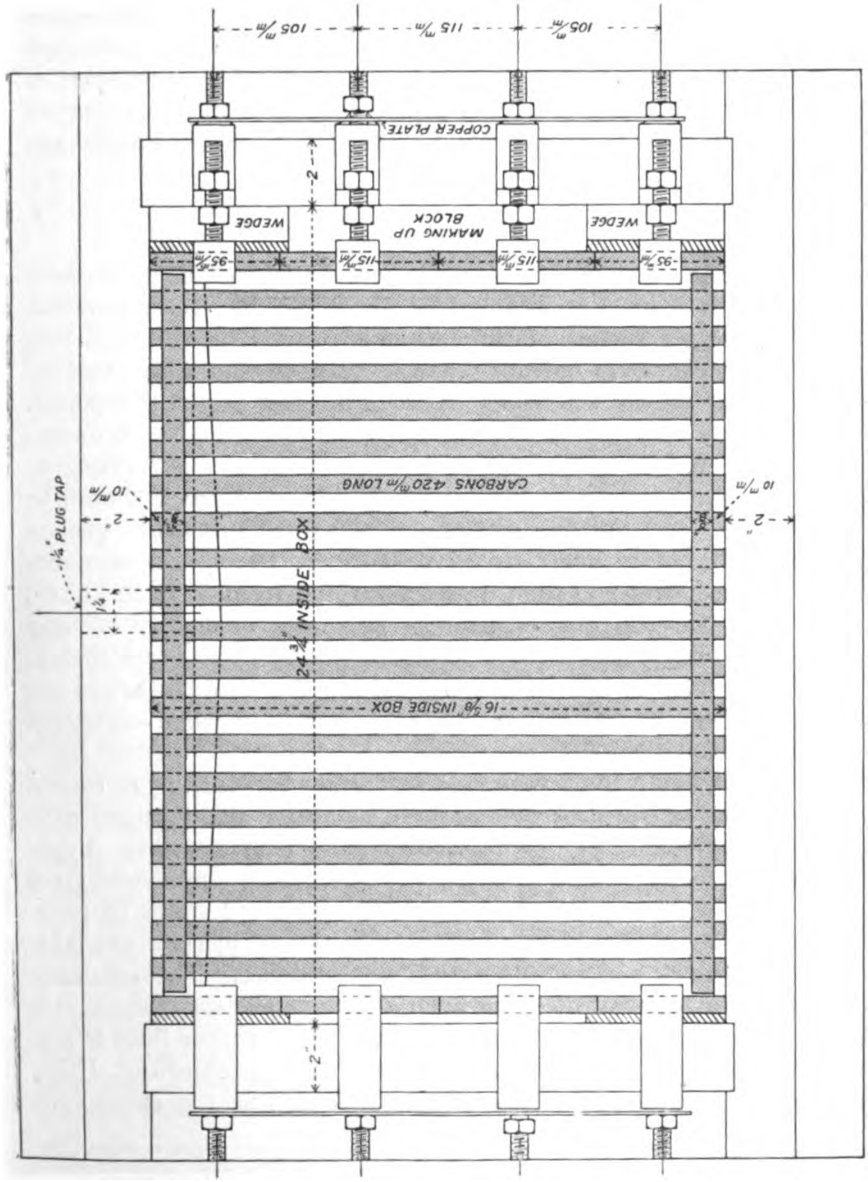
The necessary electrical connections are made as follows: two wires leading the ship's current (one hundred to one hundred and ten volts, direct current) are connected respectively with the middle pair of binding screws in the reversing switch. The two binding screws on both sides of the switch are each provided with leading wires which are attached to the electrolyzer in such a fashion that the two wires leading to either side of the switch are attached to opposite ends of the electrolyzer.

Alternating current cannot be used for the electrolysis but must be transformed. We understand that most ships furnish direct current of suitable voltage (about one hundred to one hundred and ten volts). In the case of the voltage being two hundred to two hundred and twenty volts, two electrolyzers can be placed in series.

The apparatus is extremely simple and there is nothing to get out of order. It can be easily operated by an untrained person after receiving a few minutes' instruction. The wear and tear of the apparatus is extremely small. The carbon plates are capable of giving many months' service before renewal is necessary.



20-CELL SPECIAL ELECTROLYSER.


105 m/m
115 m/m
105 m/m
COPPER PLATE
WEDGE
MAKING UP BLOCK
WEDGE
CARBONS 420 m/m LONG
24 3/4" INSIDE BOX
16 5/8" INSIDE BOX
1 1/4" PLUG TAP
10 m/m
2"

The apparatus as described above was made by Messrs. Mather and Platt, Park Works, Manchester. We are indebted to Dr. Edward Hopkinson, a director of the company, for much valuable assistance in constructing a practical and efficient apparatus. The maker's number for the first electrolyzer of this type is GM.718/15, and may be usefully quoted for identification purposes in any correspondence relative to the purchase of similar apparatus.

(3) The Operation of Electrolysis.

In order to carry out an electrolysis the tank is filled with cold salt water to a level approximately one and a half to two inches *below* the upper surface of the carbon plates. The object of this is to avoid excessive current leakage between the cells such as would occur if the sea water reached a level above the plates. If the ship is rolling, less sea water should be used at each operation. A tank of the dimensions given will hold about thirty to thirty-five litres, or six to seven gallons. The salt water should be cold in order to limit the conversion of hypochlorite into useless chlorate consequent upon excessive heating. Special experiments made with sea-water at temperatures varying from 5° C. to 25° C., show that the cell can electrolyze sea-water efficiently at any temperature likely to be encountered in practice (cf. Tests Nos. 1, 2, and 3, Table I). During the electrolysis the temperature of the solution in the cells rises about 1·5° C. per minute when a current of about 50 to 70 ampères is passing.

The tank being filled with cold salt water the current is turned on by means of the switch.[1] A brisk evolution of hydrogen with traces of chlorine is at once noticeable, and neutral sodium hypochlorite is formed in the solution. The table appended gives details of the course of electrolysis after varying lengths of time. It will be noticed that after a few minutes the quantity of available chlorine formed per minute steadily diminishes. The efficiency of the cell being greatest in the early stages of the electrolysis, it is most economical to electrolyse for a short time rather than to aim at attaining a very high concentration of hypochlorite. Using ordinary salt water, it is inadvisable to continue the electrolysis

[1] Untrained attendants must be warned against turning the current on before filling the tank and against adding salt water to the tank while electrolysis is in progress.

for more than ten minutes. With a current of 60 to 75 amperes at 110 volts, ten minutes' electrolysis will give a solution usually containing a little less than four parts per thousand of sodium hypochlorite or of available chlorine. For most purposes it is distinctly advantageous to limit the electrolysis to five minutes. Under these conditions the efficiency of the cell is high and the rise of the temperature of the solution is not great—about 7° to 8°. The solution at the end of five minutes will contain from 2·0 to 2·7 parts per thousand of sodium hypochlorite or available chlorine.[1]

The direction of the current should be reversed from time to time by turning the handle of the reversing switch in the opposite direction to that previously used. A daily reversal is probably sufficient, but it may be done more often with advantage. Current reversal keeps the carbon plates free from deposits of magnesium hydroxide, which otherwise would lower the efficiency of the cell.

When less current than sixty amperes is taken by the cell, the yield of hypochlorite is naturally lower, as indicated in Tests Nos. 6 and 7, Table I[2]. With approximately constant current the yield of hypochlorite is remarkably uniform so far as practical purposes are concerned. Where higher concentrations of hypochlorite are required, they may be obtained by electrolyzing cooled brine containing ten or fifteen per cent of salt. On shipboard, however, it would be found unnecessary.

Apart from a few particles of suspended carbon from the electrode, the electrolyzed solution will be found clear, bright and free from sediment. It should be run off into wooden tubs or other receptacles, such as slate or lead-lined vats.

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[1] The strength of the hypochlorite solution is most easily determined by taking ten cubic centimetres of the solution, adding about 0·5 gramme potassium or sodium iodide, and about one cubic centimetre of strong acetic acid. A decinormal solution of sodium thiosulphate (24·8 grammes per litre) is then added from a burette or graduated pipette until the colour of the iodine, liberated by the hypochlorite, just disappears. Each cubic centimetre of thiosulphate required corresponds to 0·00355 gramme of available chlorine or 0·0037 sodium hypochlorite. Hence, if ten cubic centimetres of hypochlorite solution is taken for analysis, each cubic centimetre of thiosulphate used is equivalent to 0·355 part per thousand of chlorine or 0·37 part per thousand of sodium hypochlorite. Starch paste may be used as indicator but is unnecessary. The thiosulphate is identical with ordinary photographic "hypo" which will be generally found on board.

[2] It is desirable to make a few tests of the output of hypochlorite on installing a new apparatus on board ship, especially when the current available differs greatly from that indicated. This, however, is a very easy matter.

(4) Cost of Apparatus and of Electrolytic Hypochlorite.

The cost of disinfection with electrolytic chlorine may be resolved into two items: (1) the initial cost of the cell, and (2) the other cost of the current used for electrolyzing the sea-water.

From an examination of the results recorded in Table I, it is calculated that when electrolyzing 35 litres of sea-water at a time for five-minute periods, using 110 volts and 75 amperes, the power required to produce a kilogramme of chlorine is approximately eight kilowatt hours. The cost of the electrical energy naturally varies enormously according to the conditions of its production—the estimates varying from 0·25 pence to 1·5 pence per unit. Taking 0·75 pence per unit as a fair average, the cost of producing 1,000 litres of hypochlorite solution at 1 : 1,000 chlorine concentration works out at sixpence. This is equivalent to threepence per 100 gallons, a figure which for practical purposes may be regarded as almost negligible.

The original cost of the cell installed on shipboard is about £50, and its depreciation is undoubtedly small. The carbon plates will last for over a year with constant use and hence much longer when intermittently worked, as on board ship. Moreover, they can be readily replaced at moderate cost. The tank itself, being of teak or cedar wood, can be easily repaired in case of need by the ship's carpenters.

Judging by certain estimates supplied to us, it is calculated that on a ship the size of H.M.H.S. "Aquitania," the economy in largely replacing expensive coal tar disinfectants, such as carbolic acid, cresol, etc., by electrolytic hypochlorite will *approximately pay for the cost of the cell in the course of a single trip of three weeks.*

(5) The Optimum Concentration of the Electrolytic Hypochlorite for Disinfecting Purposes in Wards, etc.

It is a somewhat difficult matter to select the most advantageous concentration for the disinfecting fluid. Some of the factors bearing on the question may be briefly referred to. As is well known, the hypochlorites possess extraordinarily high germicidal action when acting upon organisms suspended in pure water. One to two parts per million of hypochlorite will effectively kill, in two hours, a moderately large quantity of organisms other than spore forms. But this activity is much reduced when the hypochlorite

TABLE I.

Test number	Time of Electrolysis. Minutes	Available chlorine			Additional data
		Grammes per litre (parts per 1,000)	Chlorine formed per minute stage. Grammes per litre	Total chlorine formed. Grammes	
I	1	0·41	0·41	141·4	35 litres sea-water. Temperature at start 15° C. ,, at finish 28° C. ,, rise 13° C. Mean voltage 110 ± 1. ,, amperage 72.
	2	0·92	0·51		
	3	1·49	0·57		
	4	2·08	0·59		
	5	2·66	0·58		
	6	3·09	0·43		
	7	3·37	0·28		
	8	3·64	0·27		
	9	3·90	0·26		
	10	4·04	0·14		
II	1	0·21	0·21	135·4	35 litres sea-water. Temperature at start 5° C. ,, at finish 22° C. ,, rise 17° C. Mean voltage 110. ,, amperage 72.
	2	0·57	0·36		
	3	1·10	0·63		
	4	1·57	0·67		
	5	2·09	0·52		
	6	2·51	0·42		
	7	2·91	0·40		
	8	3·20	0·39		
	9	3·52	0·32		
	10	3·87	0·35		
III	1	0·41	0·41	136·8	35 litres sea-water. Temperature at start 25° C. ,, at finish 37° C. ,, rise 12° C. Mean voltage 100. ,, amperage 78.
	2	1·14	0·73		
	3	1·81	0·67		
	4	2·38	0·57		
	5	2·91	0·53		
	6	3·37	0·46		
	7	3·76	0·39		
	8	3·91	0·15		
IV	1	0·27	0·27	121·1	35 litres sea-water. Temperature at start 17° C. ,, at finish 30° C. ,, rise 13° C. Mean voltage 110. ,, amperage 75.
	2	1·06	0·79		
	3	1·65	0·59		
	4	2·18	0·53		
	5	2·57	0·39		
	6	2·87	0·30		
	7	3·16	0·29		
	8	3·46	0·30		
V	3	1·05	0·35	104·3	35 litres sea-water. Temperature at start 15° C. ,, at finish 26° C. ,, rise 11° C. Mean voltage 110. ,, amperage 65.
	5	2·05	0·50		
	8	2·98	0·31		
VI	10	2·31	–	69·2	30 litres artificial sea-water. Mean temperature 15° C. ,, voltage 98·7. ,, amperage 42·2
VII	10	2·7	–	67·5	25 litres artificial sea-water. Mean temperature 12° C. ,, voltage 95·8. ,, amperage 34·9.
VIII	6	5·10	–	199·7	30 litres 10 per cent NaCl sol. Mean temperature 17° C. ,, voltage 96. ,, amperage 90.
	10	6·66	–		
IX	5	5·90	5·90	178·4	25 litres 10 per cent. NaCl sol. Mean temperature 23·5. ,, voltage 96. ,, amperage 94·7.
	10	7·14	1·24		

acts in the presence of much extraneous organic matter. Thus, for example, we have found that a concentration of hypochlorite corresponding to between 1 : 1,500 to 1 : 2,000 is necessary to kill in two hours the organisms in two drops of a fresh culture of *Staphylococcus aureus* suspended in blood serum. It is obvious, therefore, that the nature and quantity of the organic matter present on the soiled surfaces which are to be disinfected is a matter of importance.

The killing of micro-organisms by many disinfectants is a chemical action between the disinfectant on the one hand and the protein and other substances in the organisms on the other. But many forms of non-living organic matter are capable of reacting with the disinfectant as well. Many of these substances, including protein, volatile organic bases, urea, and ammonia react with hypochlorite to yield compounds of the chloramine group containing the NCl radical. These compounds still possess high germicidal properties, in some cases actually higher than the original hypochlorite (cf. Rideal, *Journal Royal Sanitary Institute*, 1910, vol. xxxi, p. 33; Dakin, *British Medical Journal*, August 28, 1915, and December 4, 1915). On the other hand, other substances found in dirt and dust are simply oxidized by the hypochlorite yielding products of no germicidal value. Hence for the disinfection of badly soiled surfaces, whether heavily infected or not, either an increased volume of disinfectant must be used, or a higher concentration. There are very definite limits to the quantity of organisms capable of destruction by any given amount of antiseptic.

Bearing the above points in mind, it would appear that a concentration of hypochlorite should be chosen, such as will ensure an excess of hypochlorite on the treated area, for some time after its application. This ideal concentration will of course vary with the nature of the surface treated and the amount of dirt upon it. Hypochlorite disappears rapidly when spread in a thin film on a wooden surface, less rapidly on linoleum, still less rapidly on rubber surfaces, while on a clean glass surface the hypochlorite may persist for thirty-six hours or more.

Practically speaking, it will be found that a strength of about 1 per 1,000 sodium hypochlorite or available chlorine, when properly applied, will suffice for all ordinary purposes. On slightly contaminated smooth surfaces such as glass, rubber and certain composition floors, 1 per 3,000 or even less would probably be found sufficient, but no disadvantages follow the employment of the stronger solution. Electrolytic hypochlorite at a concentration of 1 per

1,000 available chlorine can be used freely in the wards for swabbing and mopping the floors, walls, latrines, etc., without objectionable after-effect. This solution was conveniently obtained by taking the electrolyzed sea-water through which the current had been passed for five minutes, as described in Section III, and diluting each bucketful of this liquor with a bucketful of fresh salt water. The diluted mixture was kept in a large tub from which it was distributed to the wards.

The germicidal action of this mixture tested against typhoid organisms, under the conditions of the Walker-Rideal test, may be calculated from the experiments of Klein, Sommerville and Walker, Rideal and others. When diluted 20 times (*i.e.*, a chlorine concentration of 1 : 20,000) it is as active as 1 per cent phenol.

Comparative experiments upon the bacteriological conditions of floors before treatment, after treatment with salt water and after treatment with hypochlorite at 1 in 1,000, showed a huge reduction in the number of organisms to follow the applications of hypochlorite, while a large reduction followed the use of plain sea-water. These experiments are being continued.

(6) The Uses of Electrolytic Hypochlorite as a Disinfectant in Wards, etc.

The hypochlorite solution prepared as described in the previous section, by mixing equal volumes of salt water, electrolyzed for five minutes, with plain salt water, was kept in large wooden tubs at convenient places near the wards on the different decks. Each morning, after the floors had been brushed, a company of sanitary orderlies, carrying the solution in wooden buckets, mopped every portion of the floor surface of the ward, under the beds, up the dividing walls and in the lavatories.[1] On the wooden decks now enclosed and used for wards the solution drys very quickly, while on linoleum, owing to its non-porous character, the wet surface takes longer to dry. It is desirable, therefore, that on linoleum a too large excesss of liquid should not be left, or else a slippery moist surface persists for an inconveniently long time. It is important that the orderlies be instructed to change the disinfectant in their buckets at frequent intervals. The re-distribution of dirt

[1] It may be of interest to mention the fact that the distance of corridors, floors, etc., mopped with the disinfectant exceeded three miles. In most cases it was possible to make one daily application only.

mixed with a little disinfectant of impaired activity over the surface of a ward does not constitute cleaning, and it is necessary that this is understood by the orderlies.

In the enteric and dysentery wards hypochlorite disinfectant was placed in the bed-pans before use and its marked deodorant action was much appreciated. After cleaning the bed-pans with a special spray, they were well rinsed with hypochlorite solution. At frequent intervals the disinfectant was used for mopping all the surfaces in the latrines, including the door-handles, and from time to time it was poured down the waste-pipes, followed by a good flush of salt water. When used in this way we have not observed damage to plumbing greater than that caused by other disinfectants. We shall be in a position shortly to know the results of an actual examination of the plumbing in latrines where hypochlorite has been used, and to make a comparison with similar structures in latrines treated with phenolic disinfectants.

As is well known, intermittent use of electrolyzed sea-water has been successfully employed on French naval ships to render urinal and water-closet traps unobjectionable (cf. Gatewood, "Naval Hygiene," p. 443, Rebman, 1909). Similar trials have been made, we understand, on British warships, but the method has not been continued on account of corrosive action. We have no details as to the concentration and quantity of hypochlorite used and these are essential points.

It is worth noting that electrolytic hypochlorite can be used in conjunction with soap, and some particularly heavily soiled decks were cleaned with this mixture. It is probable, however, that reduction in the germicidal action of the hypochlorite is followed by the addition of the soap.

The hypochlorite was also used for putting in the spittoons of tuberculosis patients and for other similar purposes for which disinfectants are commonly employed.

The results of the free use of hypochlorite in the wards has been most gratifying. It seems to be the unanimous opinion that the wards were fresher, cleaner and freer from objectionable odour than they were previous to its use. We have now had the experience of two voyages to the Mediterranean during which the hypochlorite has been used, and the general opinion is strongly in favour of the hypochlorite as contrasted with phenolic disinfectants. In the typhoid and dysentery wards the results have been particularly striking and the absence of odour most marked.

The most important effect of all has been the large reduction in secondary infection occurring among the ship's staff following upon the introduction of hypochlorite disinfection. While it would be unfair to refer this fortunate result as exclusively due to the hypochlorite, it is generally considered among competent observers that the introduction of the hypochlorite has been an important cause of the improvement.

(7) Rate of Decomposition of Electrolytic Hypochlorite on Keeping.

It is well known that hypochlorite solutions prepared by the direct electrolysis of sea-water are unstable. For practical purposes of disinfection, etc., on shipboard and in other places this is of no moment, since the solution is readily prepared as needed and there is no need for lengthy storage. A few experiments are recorded showing the rate of decomposition of hypochlorite prepared from the electrolysis of sea-water, when stored in the shallow wooden tubs which were employed for holding the solution in the wards and elsewhere. These conditions were chosen as being the most unfavourable for the stability of the hypochlorite. It will be seen that on the average the rate of decomposition was about twenty-five per cent of the hypochlorite present in twenty-four hours. The rate of decomposition is influenced by temperature and by free exposure to air. When stored in covered vats the rate of decomposition is materially less. Since the electrolytic hypochlorite is so readily and cheaply prepared it is well to reject solutions which have been stored for more than two or three days.

TABLE II.

Date	Available chlorine in parts per 1,000	Percentage decomposition in twenty-four hours
December 19	2·34	27
,, 20	1·68	28
,, 21	1·31	22
,, 22	1·01	23
,, 23	0·77	24
,, 24	0·53	31
,, 25	0·36	32
,, 26	0·24	33

(8) Purification of Ship's Drinking Water by Means of Hypochlorite.

The treatment of potable water of questionable purity with hypochlorites it so widely practised that only a brief reference need be made to this important application.

In using electrolytic hypochlorites for water treatment, it is well to use as small a quantity of as concentrated hypochlorite as possible, in order to avoid a bitter taste owing to the addition of unnecessarily large quantities of salt water. Possibly it would be preferable to electrolyze a pure salt solution and so avoid the addition of magnesium chloride; but the following method gives perfectly satisfactory results: A hypochlorite solution was prepared by electrolyzing sea-water for ten minutes, and contained 3·7 parts of available chlorine per thousand. This was added to eighty-seven tons of water in such proportions that the mixture contained about 1 in 1,000,000 of chlorine. The quantity of available chlorine needed was 0·2 lb.; hence five gallons of the electrolyzed fluid were added. A bacterial count made before and three hours after treatment of the water showed a reduction in organisms from 10,626 per cubic centimetre to 60 per cubic centimetre. Four days later the count was 346 per cubic centimetre, while another treated specimen of water gave 286 per cubic centimetre. It is important to avoid adding more hypochlorite than is necessary, as otherwise the taste of the water is impaired; 1 in 1,000,000 is sufficient for all ordinary purposes, and the instability of electrolytic hypochlorite is so great that after three or four hours all traces of chlorine will have disappeared.

(9) Surgical Uses of Electrolytic Hypochlorite as an Antiseptic.

The employment of sodium hypochlorite in the antiseptic treatment of wounds has been extensively practised in the course of the present War, with results which are by many considered superior to those obtained by other methods.

It appeared probable, therefore, that electrolytic hypochlorite prepared by the electrolysis of sea-water might be a valuable antiseptic dressing for infected wounds. The electrolytic hypochlorite is free from excess of alkali, and reacts faintly acid to phenolphthalein, and appears most suitable for surgical use. In addition, the presence of the sodium and magnesium salts in the sea-water

might be expected to have a beneficial lymphagogic action similar to that observed in the hypertonic salt solution treatment of wounds advocated by Sir Almroth Wright.

So far as we are aware, the first use of electrolytic hypochlorite for surgical purposes was made on the French hospital ship "Charles Roux," and after three months' experience of the treatment the principal medical officer, Dr. Heitz-Boyer, and his staff expressed themselves as entirely satisfied with the results. It is, perhaps, worth noting that most of the "Charles Roux's" cases came from Cape Helles, where the wounds are well known to be badly infected. Thanks to Dr. Heitz-Boyer's kindness we have had an opportunity of spending several days on the ship, and have seen the solution extensively employed on about two hundred purely surgical cases. A much wider adoption of the electrolytic antiseptic is being arranged for by the French authorities both on hospital ships and on shore.

On a recent trip on the H.S. "Aquitania," thanks to the kindly interest of Lieutenant-Colonel Fuhr, it was possible to use the electrolytic hypochlorite on a number of suppurating injuries, many of them originally due to frost-bite. The results are clinically similar to those observed with hypochlorite prepared from bleaching powder (*cf.* Dakin, *British Medical Journal*, August 28, 1915), but it is well to use a slightly lower concentration. The sea-water, electrolyzed for five minutes, using about 65 to 70 amperes at 110 volts, containing two to two and a half parts per thousand of sodium hypochlorite, is a good concentration for general use, and may be used also for irrigating purposes. It is most important that the solution be used freely, and that the whole surface of the wound be kept thoroughly moist with the antiseptic solution.

It is not suggested that the electrolytic hypochlorite is superior to the mixture prepared according to the formula given in the paper above referred to—in fact, many observers are inclined to prefer the latter.[1] But the extreme ease of preparation of the electrolyzed solution, the only raw materials needed being sea-water and electrical energy, might make its use possible and

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[1] Those interested in the antiseptic treatment of wounds with sodium hypochlorite may care to consult articles in the following issues of the *British Medical Journal:* August 28; October 23, p. 609; November 27, pp. 778, 790; and December 4, 1915.

desirable under conditions where the preparation of the more complicated solution is difficult.

The electrolytic hypochlorite for surgical use should not be kept for more than twenty-four to forty-eight hours.

(10) Other Uses of Electrolytic Hypochlorite.

There are a number of applications for electrolytic hypochlorite of minor importance. Among them may be mentioned its use in the butcher's department, for destroying odours from flesh and fish. The application of hypochlorite at intervals to the floors by mopping has given very useful results.

The hypochlorite has been used in the laundries, especially in some of the French boats, for soaking undyed cotton and linen goods. Its action is as follows: it acts as a disinfectant for infected linen; it has a marked action in loosening dirt, and lastly a bleaching action. It is important that the hypochlorite for laundry purposes be well diluted. The liquid obtained by diluting the fluid obtained after five minutes' electrolysis with ten to twenty parts of water is of suitable concentration, i.e., about 0·12 to 0·25 per thousand of available chlorine.

Another application for the hypochlorite is for purifying the water of swimming baths as practised in the Bow and Poplar swimming baths. In the case of the heavily infected salt water frequently found in harbours and ports, particularly those of the Mediterranean, where tidal purification is slight, the use of electrolytic hypochlorite might easily find important application.

An experiment made in the swimming bath on the "Aquitania" showed that adding electrolytic hypochlorite to five hundred tons of salt water in the proportion of 1 in 2,000,000 of available chlorine, caused a reduction in the number of organisms, in two hours, from two thousand to two hundred per cubic centimetre, i.e., a ninety per cent reduction.

In conclusion, the question may be raised as to whether electrolytic hypochlorite may not find a useful application for cleansing land which has become heavily fouled by latrines, etc. In 1895 the cleansing up of Rikers Island, New York Harbour, after the island had become a public nuisance for miles around owing to its prolonged use as a garbage dump, was readily effected by spraying electrolyzed sea-water, prepared on a barge, over the surface of the decomposing material.

(11) The Action of Electrolytic Hypochlorite on Various Structural Materials.

Hypochlorites, we well know, exert a marked corrosive action upon iron and steel, and this fact has unfortunately militated against their use in a number of directions. In order to gain some more definite ideas as to the action hypochlorite has upon various materials likely to be encountered on shipboard, a number of experiments were made employing hypochlorite at a concentration of 1 in 1,000 of available chlorine, this being the strongest solution recommended for use in disinfection. In most cases a gramme of material finely divided so as to expose a considerable surface was put in contact with ten cubic centimetres of the hypochlorite for from two to six hours. The amount of corrosion, if any, was then noted and the residual hypochlorite determined by titration. Naturally these experiments are purely of a comparative kind. The materials used were those actually in use on this ship. The results may be summarized as follows:—

Clean iron and steel are attacked to a marked extent by 1 in 1,000 hypochlorite, and the action is relatively rapid. Copper is much more slowly attacked but the action is definite. Brass is still less attacked, while aluminium, zinc, nickel, and tin are scarcely attacked at all under the conditions of the experiments. Lead is the most resistant of all the metals tested. Tin plate, nickel plate, galvanized iron, are not appreciably attacked if the plating is intact.

Organic materials such as wood, linoleum, rubber, composition floorings of various kinds, take up a certain amount of hypochlorite, as would be expected. Wood is the most active in this respect and rubber the least, but in no case is significant damage done to the material. Wooden tubs which have contained strong hypochlorite solutions for long periods develop a soft whitish deposit on the surface, but if this is not scraped off further action soon ceases. Painted wood and metal, at least so far as the materials tested were concerned, proved to be very resistant. None of the floor surfaces in the wards on board ship showed significant damage. The only complaint being, as already noted, that occasionally the saline hypochlorite dried rather slowly on damp days on the linoleum surfaces. But this is due to the non-absorbent character of the linoleum, especially when more or less saturated with salts from previous applications, rather than to any destructive action. The conditions can be easily remedied by occasional washing with fresh water. Under the conditions adopted on board the "Aquitania"

for applying the hypochlorite it may fairly be said that no significant damage to ship structures is observable after two months' use.

(12) Summary.

A cheap, simple and efficient cell for the electrolysis of sea-water, suitable for use on shipboard, has been devised. The most advantageous conditions for operating the cell are described in detail. The cost of production of the hypochlorite is found to be extremely small. The hypochlorite has been most successfully used for general disinfecting purposes, for washing the wards, latrines, etc. It has also been used for the purification of ship's drinking water. And lastly, it has been found to be an excellent antiseptic for surgical use. A number of other applications have also been studied.

By request, Lieutenant-Colonel R. H. Fuhr, who has shown great interest in the use of hypochlorite, has recorded his opinions as to the value of the method. His statements will be found in the concluding section.

Remarks on the Use of Electrolytic Hypochlorite. By Lieutenant-Colonel R. H. Fuhr, D.S.O., R.A.M.C.

My observations are confined to the purely administrative side of this most excellent and efficient antiseptic. Dr. Dakin's report, with which I entirely concur, is so complete that there is little left to add.

(1) *Cost.*—The cost is so small that a very large saving to the public must necessarily occur as the process becomes more widely used.

(2) *Apparatus.*—The apparatus is very simple and requires the minimum of intelligence for its working. The training in its use is therefore very short.

(3) *Purification of Water.*—For the purification of drinking water on board ship it is a quick, simple, and very easily worked method, giving a clear potable water, with no appreciable taste or smell. It is important that thorough mixing should take place, as otherwise the water, if drunk within an hour of treatment with hypochlorite, has a slight smell and taste, which, however, rapidly passes off.

(4) *Antiseptic Uses.*—As an antiseptic for surgical purposes I consider, as a result of personal observations, it is the best. Two points are important in its use :—

(*a*) When great frequency of application is necessary a high dilution is advisable.

(*b*) The fact that the hypochlorite combines with the proteins of the tissues, forming substances of the chloranine group, an antiseptic being thus formed *in situ*, should be borne in mind. Such means as filling with fresh hypochlorite solution a rubber drain inserted in the dressing of a wound or the gauze bandage constant irrigation method as practised by Wright, are required to obtain the maximum effect.

I have been much impressed by the results obtained and also by the fact that on changing gauze dressings they readily peel off without pain or bleeding of the granulations. My officers consider that the chemically made balanced solution is less irritating; but to my mind this is really a matter of dilution and increased frequency of dressing.

(5) *Deodorant Uses.*—For sanitary use I am absolutely convinced that it is the best, cheapest, and most easily applied method available. I can discover no harmful effects on any of the wards. As a deodorant it is invaluable. This hospital ship, accommodating more than the seven largest London hospitals, has given me full opportunity for forming a carefully considered opinion, particularly as large numbers of dysentery and paratyphoid cases have been carried.

The confinement of approximately four thousand patients in a limited space renders essential most stringent sanitary precautions, and I have satisfied myself that for efficiency, economy and utility, electrolytic hypochlorite is very essential for hospital ships.

In conclusion, I am much indebted to Dr. Dakin for his very great kindness and help to me personally and to my officers. He has placed the use of the cell, which belongs to the Medical Research Committee, at my disposal, and I most strongly urge that the War Office purchase the same as soon as possible.

A SANITARY SECTION AT THE FRONT.

By Captain G. LESLIE EASTES.
Royal Army Medical Corps (T.F.)

The war establishment of a sanitary section consists of a Commandant, either Captain or Lieutenant, two Serjeants, one of whom is a Staff-Serjeant, two Corporals, one Lance-Corporal, and twenty men, all drawn from the Royal Army Medical Corps, Territorial Force, and attached to the section are two drivers from the Army Service Corps. The equipment includes two box sterilizers (current steam), one water clarifier and sterilizer, numerous brooms, watercans, pails and flagpoles (to mark the position of latrines), with some Mackenzie sprays, spades, pickaxes, butchers' and carpenters' tool boxes and three circular tents; for transport and forming part of the equipment either a motor lorry or general service wagon, according to the terrain in which the section is going to operate. Concerning the general service wagon it may be remarked that its carrying capacity is insufficient and that the addition of a maltese cart is indispensable, and the number of horses or mules and of drivers must be correspondingly increased.

With reference to the personnel, as stated above, all belong to the Royal Army Medical Corps, Territorial Force, but the Commandant need not necessarily be a member of the medical profession, provided he has some sanitary qualification, e.g., sanitary engineer or architect. Nevertheless, a medical qualification is very desirable for many reasons, not least being that the Commandant is then able to treat the minor ailments and casualties of his men and thereby keep his ranks intact, a desideratum difficult of attainment when the sick have to report to the medical officer of some other unit.

The rank and file are selected as far as possible from employees of sanitary authorities and firms, and should include one laboratory assistant. The composition of my own section might serve well as a model. It includes four qualified sanitary inspectors, three Borough Council employees, skilled in road and drainage works, one builder, one skilled disinfector and one carpenter. The remainder had no special pre-war sanitary experience, but are intelligent young fellows, who speedily acquired knowledge of the work required of them. As far as military considerations allow non-commissioned rank should be given to the sanitary inspectors.

Two men should be trained before going abroad as cooks, another as orderly clerk, and another as quartermaster. The laboratory assistant, if obtainable, will be of most service if he has been trained in an analytical laboratory.

The Commandant has a difficult and arduous post to fill, as he combines in himself the functions of commanding officer, adjutant, medical officer, quartermaster, orderly officer, paymaster and censor, and is, therefore, never off duty. My experience shows that it would be advantageous, under the conditions of active service, for the Commandant to have a junior officer, who would relieve his senior of much of the routine sectional work. Again, the Commandant may find his job a very solitary one, if he is so situated that he cannot join a mess, as was my position for nearly three months.

Outside his own section the Commandant, as may be surmised from the junior rank assigned to him, has no executive power, but is solely advisory and critical. It is even doubtful whether he is a "sanitary officer" in the sense in which the Army uses the term, the point having been left ambiguous, possibly purposely, as the formation of sanitary sections is quite recent, and the test of war is required to demonstrate the justification for their existence. Again, a section may find itself under the control of a D.A.D.M.S., an officer of field rank, who may be appointed as a specialist sanitary officer to the base in which the section is working.

In pre-war days it was laid down that sanitary sections are lines of communication units, but after the various bases and intermediate bases had been supplied with sanitary sections the idea was conceived of allotting a section to each division. But my own section, though originally a divisional unit, has also acted as an intermediate base and advanced base unit within a period of five months, and this has militated against its proving itself, but of course has widely extended its experience. The constant changes have so far never allowed it to complete its work in any one sphere, and with each change has come a different set of conditions to which the section has had to accommodate itself, and a different personnel with whom to make itself acquainted. No doubt a section which has been definitely allotted either as a line of communication or divisional unit, is better able to show good results than one which, like my own, is placed under a new set of circumstances every two months. At present the section is stationed at an advanced base in the Mediterranean within a mile of the firing trenches, and there I trust it will be allowed to remain.

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Two men should be trained before going abroad as cooks, another as orderly clerk, and another as quartermaster. The laboratory assistant, if obtainable, will be of most service if he has been trained in an analytical laboratory.

The Commandant has a difficult and arduous post to fill, as he combines in himself the functions of commanding officer, adjutant, medical officer, quartermaster, orderly officer, paymaster and censor, and is, therefore, never off duty. My experience shows that it would be advantageous, under the conditions of active service, for the Commandant to have a junior officer, who would relieve his senior of much of the routine sectional work. Again, the Commandant may find his job a very solitary one, if he is so situated that he cannot join a mess, as was my position for nearly three months.

Outside his own section the Commandant, as may be surmised from the junior rank assigned to him, has no executive power, but is solely advisory and critical. It is even doubtful whether he is a "sanitary officer" in the sense in which the Army uses the term, the point having been left ambiguous, possibly purposely, as the formation of sanitary sections is quite recent, and the test of war is required to demonstrate the justification for their existence. Again, a section may find itself under the control of a D.A.D.M.S., an officer of field rank, who may be appointed as a specialist sanitary officer to the base in which the section is working.

In pre-war days it was laid down that sanitary sections are lines of communication units, but after the various bases and intermediate bases had been supplied with sanitary sections the idea was conceived of allotting a section to each division. But my own section, though originally a divisional unit, has also acted as an intermediate base and advanced base unit within a period of five months, and this has militated against its proving itself, but of course has widely extended its experience. The constant changes have so far never allowed it to complete its work in any one sphere, and with each change has come a different set of conditions to which the section has had to accommodate itself, and a different personnel with whom to make itself acquainted. No doubt a section which has been definitely allotted either as a line of communication or divisional unit, is better able to show good results than one which, like my own, is placed under a new set of circumstances every two months. At present the section is stationed at an advanced base in the Mediterranean within a mile of the firing trenches, and there I trust it will be allowed to remain.

Certain of the sections have developed special functions, others work on a broader basis. These differences depend mainly upon the proximity of the district occupied to the firing line or upon special local conditions, and to a less degree upon the training or aptitude or proclivities of the Commandant. For example, some sections have specialized on provision of bathing facilities or water purification, whilst others seem to be hardly more than scavenging squads. The theory underlying the formation of a sanitary section is that it is a skeleton to be filled out with unskilled labour to form a large body of workers either (1) in a district which is occupied by successive bodies of troops or where sanitary works are entirely lacking or very crude and require to be developed, or (2) in the case of a divisional section, as a body of overseers or inspectors.

At the advanced base I was given command of a second section, much reduced in numbers when I took over, the Commandant of which had gone sick. I found a foul area closely packed by men and stores, etc., the men living in dug-outs; the uncovered ten feet deep latrine trench system in use, water supply restricted, much diarrhœa amongst the troops, lax sanitary supervision; clothes disinfection though urgently required being carried on quite spasmodically, and the whole area under occasional shell fire, with stray bullets wandering overhead at all hours; but sea bathing was possible and contagious diseases practically negligible. At the time of our arrival the considerable task of removing men and stores from the crowded to a more spacious area had been taken in hand and was being prosecuted with energy. Transport was naturally limited but was being improved. Almost everything requisite for sanitation had to be imported or improvised. Here naturally was scope for wide and strenuous activity and we became veritable artists in improvization.

As the latrine areas were nearly used up and as the question was represented to me to be urgent, I at once set to work to provide for the new area a latrine system working on the destruction principle, and upon the public lavatory system, endeavouring to abolish the regimental latrine. To this end sites were selected where gullies converged, or where troops congregated, e.g., near pier heads, supply depots, etc. Upon each site seat latrines accommodating ten men and two officers were constructed, cresol drums, supplied with wire handles, utilized as pails; underground fly- and stench-proof urinals were constructed, triangular incinerators, having a sloping top and chimney of stones and mud, were built. For the grid of the latter, iron bars from wrecked lighters, Turkish

bayonets, etc., proved useful. Each latrine area was also provided with a large tub for reception of dry refuse from the nearest lines. This and the addition of damaged hay (which I commandeered) to the well-oiled pails formed an inflammable material easily consumed by the incinerators. Men were instructed to urinate before using the pails and quickly accustomed themselves to the system. Crude petroleum was used for cleansing the pails, and a liberal sprinkling of chloride of lime over the area diminished the fly-plague. One lesson I have learnt is that in dry climates, cresol or other aqueous solutions, except formaldehyde, are useless against flies. Upon the sloping top of the incinerators fire-plates were to be laid before the wet weather set in; this, with the addition of a cowl to the chimney it was hoped would permit incineration in the rainy season. Later, I intended to add two Serbian disinfector barrels to each latrine area. The whole site was placed in permanent charge of one man, whose duty it was to see that separate urination before defæcation was observed, to cleanse and oil the pails and incinerate the contents. In carrying out these constructional works, the men, who had been Council employees, were most useful.

The next step was to divide the beach areas into districts, approximately equally peopled, and place a man of the sections in charge. His duty was to acquaint himself with the location of each dug-out, to inspect daily and to report irregularities to me. Officers commanding units were requested to see that night urine tubs and wet and dry refuse bins were established in their lines: the night urine tubs to be emptied every morning into the underground urinals and the contents of the dry refuse tins emptied into the large refuse barrels placed in the latrine areas.

The Thresh disinfector was started and kept in continuous action by appointing three squads of two men each from the sanitary sections. These squads worked eight-hour shifts; fortunately each section contained one man who was an expert disinfector.

Then the water problem was taken in hand. The water is brought mainly in lighters and pumped thence to tanks placed in various spots. From these tanks it is distributed in galvanized water vessels to the troops. Arrangements were made to allow each tank to be thrown out of action in rotation, so that it might be cleansed, and two men were detailed for this particular work. I was just taking up the question of cleansing the water-vessels and the men's own water-bottles when I had to leave. I found that there had been no systematic cleansing of these articles and men were to be detailed for this duty.

Finally, there was the problem of flies and lice in various quarters, e.g., dug-outs, stores, staff-quarters, etc. Fortunately, I found a supply of vermorel sprayers and could spare one or two men for this work. In this way practically all the men of the two sections were appointed to some special duty and consequently each could go about his work without having to be specially detailed from day to day.

At all times there were certain other duties which fell to the lot of the sanitary sections to perform. Dead mules to be towed out to sea, by arrangement with the Naval Transport authorities, but we supplied the beach party and also the butcher, whose unpleasant task it was to rip open the animals at sea to ensure the carcase sinking. Generally, this duty had to be performed under cover of darkness. Then there were fatigue parties allotted to us to help clear up the mess which still littered the ground, much of it dating back to the original capture of the various gullies. For these parties the sections supplied the supervision. All that was inflammable and unusable was burnt.

One of the most difficult items to deal with is the enormous and ever-increasing number of empty tins, with which the British Army is always hampered. After incineration these were stamped flat and thrown into abandoned and disused dug-outs and saps, but as soon as all these are filled, the labour of digging pits will have to commence again, unless arrangements can be made to procure two false-bottomed lighters to convey the debris out to sea. Certainly the working of this system would present difficulties in heavy weather, but I do not think these difficulties insuperable, if the Naval Transport authorities cordially co-operate.

The last problem I had for solution was the provision of hot baths in winter. With restricted fresh water supplies and an area under shell-fire this is certainly a difficult matter. I put forward the suggestion that canvas baths similar in all respects to those which form part of an officer's equipment should be procured in large numbers, flying column kitchens constructed for the heating of water in cresol drums, and I had hoped that the rainy season might present us with sufficient water in the wells dug by the sappers to allow from three to five gallons of water per man. Three would be sufficient, five ample to allow men to have a luxurious hot splash-bath and by the erection of shelters in the various gullies to which water from the wells could be taken in the water-carts, which are on the scene, I considered that the problem would be solved. So far, I have not heard what reception the suggestion has met with.

And now a few words of advice to Commandants who have not yet left home. Upon arriving at the scene of operations report to the superior officer under whom you will have to act. This will probably be the D.A.D.M.S. Also consult with the C.R.E., as it is essential to secure the co-operation of the Engineers. Get yourself, if possible, attached to a mess. Learn all that is known of water supplies, drainage, infectious diseases and other sanitary matters, and go over your district thoroughly. Having digested the information obtained, assign definite duties to the men of the section, and divide up the area into relatively equal subdivisions, using space or population as your basis of division, and place a man in charge of each sub-area.

One last word and I have done. I do not wish it to be thought that all the various sanitation works I had in hand were carried through to a successful conclusion, because I left owing to sickness, before that was possible. But all had been put in train and I trust that my successor will have found it easy to complete the works commenced. My task was lightened and rendered a pleasure by the very special favours extended to me by my chief, whose interest and kindness I can never requite.

Clinical and other Notes.

ASEPTIC MENINGITIS FOLLOWING INTRATHECAL INJECTION OF ANTITETANIC SERUM.

By Captain A. T. INGLETON.
Royal Army Medical Corps.

During the latter half of September and October, 1914, we had under treatment several cases of tetanus. As the most important help in the treatment of this disease is its early diagnosis, it was inevitable that a great many "suspect" and doubtful cases cropped up and that many patients were submitted to antitetanic treatment when there was no such necessity. The routine adopted in a doubtful case was as follows: A general anæsthetic was given, and a spinal puncture performed, five hundred units of antitoxin being injected in place of the lost fluid. This procedure was repeated, if necessary, every twenty-four hours. I may here mention that the induction of general anæsthesia may make more evident the rigidity of the jaws, or may make appreciable a stiffness that was not previously apparent. The procedure has thus a definite diagnostic value. In these doubtful cases I noticed that after intrathecal injection many of the patients showed rigidity of the spine, and this was taken to confirm the diagnosis of tetanus. It struck me, however, that the injection of serum into delicate structures such as the meningeal spaces of the cord might cause irritation, together with backache and spinal rigidity. I accordingly examined the cerebrospinal fluids of all patients before and after the reception of tetanus antitoxin intrathecally.

The results are what would be expected. Before the injection the cerebrospinal fluid was clear, sterile, &c. Twenty-four hours later the average number of cells per cubic millimetre was four hundred, with ninety-five to ninety-seven per cent polymorphs, and three to five per cent small lymphocytes. No large lymphocytes or eosinophile cells were ever seen, and all fluids were discarded which contained red blood corpuscles. Cultivations with and without preliminary "enrichment" by incubation remained invariably sterile. Such were the typical results. An interesting phenomenon occurred in some cases. After the first injection, a second injection was better tolerated, and the fluid was almost clear on puncture twenty-four hours after the second dose.

One very extreme instance may be noted. Patient had symptoms of definite tetanus on February 21, 1915. The cerebrospinal fluid was clear and reducing action was normal; there were no cells; 3,000 units antitoxin were given intrathecally (six times usual dose).

Twenty-four hours later the following results were obtained: fluid

microscopically, pus; 1,600 cells per cubic millimetre; ninety-seven per cent polymorphs, three per cent small lymphocytes; cultivation sterile.

On post-mortem examination, the cord showed numerous white plaques on its surface with organizing lymph, and recent adhesions at the base of the brain. The cord has been sent to the Medical History Committee, Royal College of Surgeons. This was merely an extreme case; in every case examined a definite meningitis was found.

The following points may be noted:—

(1) The cells observed in the fluid do not come from the serum injected.

(2) The reaction is purely local and does not follow subcutaneous injection.

(3) The cause is probably simply the irritation due to the high albumen content of the serum. It is not probably due to the poisonous nature of the split proteins as has been suggested.

(4) There is a danger that cases may be wrongly diagnosed as tetanus, the diagnosis being "clinched" by the meningitic rigidity of the spine following a first dose of antitoxin intrathecally.

(5) The facts above cited should be considered before the administration of serum intrathecally to any patient who has not already got meningitis.

THREE CASES OF GUN-SHOT WOUND OF THE SUPERIOR LONGITUDINAL SINUS.

By Captain A. W. NUTHALL.
Royal Army Medical Corps (Territorial).

The observations of Lieutenants-Colonel Gordon Holmes and Percy Sargent on "Injuries of the Superior Longitudinal Sinus," recently published,[1] are so striking as to arrest the attention of all who are concerned, as neurologists, clinicians or surgeons, with the care of cases of gun-shot wounds of the skull. They have demonstrated that injuries of the superior longitudinal sinus give rise to a peculiar set of symptoms which constitute a definite clinical picture, briefly—paralysis with rigidity of the voluntary muscles, with a tendency to progressive recovery without contractures or other permanent nervous defects.

I venture to report three instances of this particular injury which have come under my notice during the past month. I was puzzling over the curious and anomalous symptoms presented by my first case when I received the *British Medical Journal* on October 4 (in France), and read therein their account of "the typical case," which might almost

[1] *Brit. Med. Journ.*, October 2, 1915.

have been written of my patient; the coincidence was as remarkable as the paper was opportune and illuminating. My second and third cases died and allowed of post-mortem examination. No. 2 was moribund on admission and died from hæmorrhage. No. 3 succumbed after operation, there being extensive destruction of the brain as well as the injury to the sinus.

Case 1.—Private W. G. H. was shot in the head during the night of September 30 and October 1. He lost consciousness at once, alarming hæmorrhage occurred and subsequently pertistent vomiting. He was admitted to our casualty clearing station at 5.30 p.m. on October 1, conscious, but in a very grave condition of collapse from loss of blood; blanched, restless, and with a rapid, feeble pulse. He said he was paralysed and was found to be almost universally rigid. There was retention of urine, requiring the use of a catheter. There were two wounds on the top of the head, about two and a half inches apart, and on each side of the median line; the entry wound on the left side, the exit wound on the right of the mid-line and nearly an inch behind the former; they led to a perforation in the subjacent skull, situated just in front of the mid-point of the mid-line. His mind was clear and his speech unaffected. There was no ocular paralysis; the pupils were equal and active. There was left facial paralysis of cerebral type. No other cranial nerves were affected. An examination of the fundi was not made. The arms were held tightly clasped to the body; elbows adducted to the sides, and forearms flexed across the chest; hands clenched. Fingers, wrists, elbows and shoulders were all rigid, increasingly so up the limb. He had no voluntary control over the arms. No reflexes could be elicited in the biceps or triceps. The abdominal muscles were fixed and took no part in respiratory movement; the umbilical and epigastric reflexes were absent. His legs were stretched out rigidly to their fullest extent, rotated in so that the patellæ touched each other, and the feet were crossed; the feet were extended almost in a straight line with the legs, and turned inwards. He had no control over the legs. The knee-jerks were excessive; there was an extensor Babinski reflex; it was impossible to test the ankle-jerk.

On October 2 an operation was carried out. Both wounds were excised, a flap made, and the perforating tangential fracture cleared of depressed fragments and bone debris. On picking out a sharp fragment impacted in the dura it was found to have penetrated and to lie in the longitudinal sinus just under the edge of the bony defect. A flooding hæmorrhage from an extensive ragged wound of the sinus, and of large venous trunks on both sides was only arrested by plugging with gauze; no other method was suitable under the conditions. The flap was sutured and drainage established through the excised posterior wound. A subcutaneous saline infusion containing adrenalin 1 in 40,000 was given at once. Although almost *in extremis* from loss of blood, he rallied well

and was soon out of danger. The gauze was gradually removed and finally extracted at the end of a week. The flap healed at once, but some suppuration, finding issue through the posterior wound, persisted up to the time of his transfer from my charge.

Shortly after the operation urine was passed into the bed; in the evening the catheter was required. During the next fortnight he frequently wetted his bed; he explained that he could not wait once he felt the desire to empty the bladder. In the latter part of his stay here he had satisfactory bladder control.

On the third day after being wounded it was noted that "at times the muscles of the thighs relax, so that the knees can be flexed passively." The fingers and wrists were also much less rigid, especially the left.

On the fourth day his general condition was undoubtedly improving. There was some power of voluntary movement of the right hand and fingers (similar to athetosis), and he could move the right arm away from the body, but rigidity was present all the time and impeded these efforts; all passive movements were effected against resistance, the extensor muscles—e.g., the triceps—increasing their tonic contraction against movements. Traction on any group of muscles appeared to stimulate them to a slow, vigorous contraction. The right shoulder was more rigid than the elbow, and the elbow than the wrist. The left arm was more definitely paralysed than the right, in that there was no voluntary control at all over it. The rigidity was much less marked in this arm, except in the shoulder, which was as much or even more fixed than the right. The abdominal muscles were firmly contracted. No abdominal reflexes were present. The legs showed very little improvement. He complained of pain ("cramp") in the adductors of the thighs. The degree of rigidity of the joints diminished accordingly to their nearness to the trunk, the ankles being quite fixed, the knee and hips progressively less so. It was now possible to flex the knees and hips forcibly and so allow him to lie comfortably on one side or the other alternately.

On October 5, the fifth day, flaccid paralysis of the left arm was present, except in the shoulder, the pectoral muscles being very rigid. This flaccidity of the left arm became more obvious as it persisted throughout and showed no signs of improvement, while progressive improvement occurred elsewhere. In conjunction with the left facial paralysis it remained as a partial hemiplegia.

The rigidity of the right arm cleared off rapidly, there being none present on the seventh day. Voluntary power over the right arm was only slowly regained, and only to a partial degree, the movements of the limb being markedly ataxic on the twenty-first day, coarsely inco-ordinate excursions of the arm occurring on attempts to touch any object with the index-finger. He was able, however, to hold a cigarette on the seventh day and to feed himself on the twenty-first.

The rigidity of the legs diminished much more slowly; the hips became relaxed the earliest, the knees about a week later, but some stiffness of the ankles persisted throughout. A very limited amount of voluntary control over the legs was regained. The knee-jerks were excessive, and an extensor Babinski was always present. Ankle clonus was first noted on the seventh day; it became very much less marked subsequently.

Sensory changes were noticed to correspond with, and appeared to depend on the degree of, the paralysis and hypertonus of the muscles; they cleared up *pari passu* with the recovery of voluntary control and the disappearance of the rigidity. The sense of position was lost, nor was there appreciation of passive movements of the joints; thus, he could not tell whether the legs were crossed or the knees were being flexed; when his eyes were closed he could not say what was being done to the fingers, wrists, or elbows. The sensibility of the skin to light contact was present throughout, but touch stimuli were delayed or not correctly localized. Heat and cold were not tested. The value of subjective information of this nature is to be discounted by the very desperate condition of the patient at the time; later, when he was out of danger and well on the road to recovery, the sensory changes were confined to loss of sense of position and appreciation of movement about the ankles and legs, and there was a marked improvement in this respect when he left us.

On the twenty-first day he was evacuated to the base: I have no further information about his progress. He then had a left hemiplegia, face and arm, and considerable muscular wasting. There was a certain amount of control over the right arm, but its movements were feeble and very ataxic. He was still almost helpless, although there remained only slight rigidity of the legs and ankles. The wound of exit was suppurating as if there were still a foreign body (? gauze) beneath the scalp.

Case 2.—Private F. H. was shot in the head on October 16. He was received by us on the 17th, comatose and moribund, dying two hours after admission. He was not noticed to have any rigidity by the receiving officer.

A post-mortem examination showed a wound, three inches long, transversely across the mid-line of the vertex. There was a depressed gutter (tangential) fracture, with very little loss of bone, situated exactly over the sagittal suture; a fissured fracture extended from it downwards and outwards nearly to the left external angular process of the frontal bone. A fragment of the inner table about one inch square was separated and depressed on to the sinus, and a small sharp piece of bone had been driven into the sinus. There was a slit-like tear in the dura, about an inch in length, at right angles to the mid-line on the left side and extending across the longitudinal sinus as a laceration of its roof. The wound was situated at the junction of the middle and anterior thirds

of the sagittal suture. There was no blood-clot in the sinus. The margins of the precentral and superior frontal convolutions of both hemispheres were severely bruised, that is, discoloured by hæmorrhagic exudation. The frontal and precentral venous trunks showed up prominently on both hemispheres as purple, thrombosed, engorged vessels, with congestion of the convolutions bounding the sulci.

In this case the brain showed a localized contusion which might easily have been recovered from. Death was probably due to hæmorrhage from the longitudinal sinus, or to shock.

Case 3.—Sergeant H. E. H. was shot in the head on October 24. He was received by us on the 25th quite unconscious. The pupils were equal and active; there was no ocular paralysis. There was general rigidity of the limbs; the arms were extended by the sides of the body and rotated in; the right was less rigid than the left, allowing the passive movements without much resistance. The legs were extended and rigid, the feet turned in (but the legs were not rotated in). The knee-jerks were excessive; an extensor Babinski and marked ankle clonus were present. Urine was passed into the bed. A wound three inches long, through which brain matter was extruding, was present at the junction of the anterior and middle thirds of the mid-line of the head; it was transverse in direction and mainly on the left side. An operation was carried out within two hours of admission. A tangential perforating fracture with considerable loss of bone was exposed; there was extensive destruction of the underlying brain by deeply indriven fragments of the inner table. There was blot-clot in the mesial angle of the bony defect; in clearing this out free hæmorrhage from the longitudinal sinus occurred. A crown of bone was removed from in front, and a perforation, from which the blood poured, was closed by a suture. A drainage-tube was placed in the cavity and the wound closed. He did not rally after the operation, but quickly became worse and died four hours later.

Post-mortem Examination.—The lacerated wound of the dura mater was situated over the left superior frontal convolution, in which there was a large ragged cavity. The superior longitudinal sinus was torn completely across; ante-mortem blood-clot filled the sinus for three inches behind the wound. The four main venous trunks—frontal, pre- and post-central, and occipital, stood out prominently on both hemispheres as purple, swollen, thrombosed vessels, giving an appearance of intense congestion to the greater part of the upper portion of the brain. The left prefrontal venous trunk had been destroyed.

Holmes and Sargent emphasize the favourable prognosis of injuries of the superior longitudinal sinus, but their "experience has shown that the results of surgical interference have been extremely unsatisfactory." I believe that in my two cases it would have been better to have confined the interference to strictly conservative measures. My first case very nearly died after operation; the end of the second was probably

hastened by the operative interference. In dealing with a case presenting symptoms of "the longitudinal sinus syndrome" I am inclined to think that the surgeon should hold his hand unless the arrest of hæmorrhage or the relief of definite compression is called for—in other words, there should be no interference.

REPORT ON POST-MORTEM EXAMINATION OF E. R., AGED 21, GERMAN PRISONER OF WAR.

By Lieutenant Crabbe.
Royal Army Medical Corps.

Patient was "gassed" on September 25, presumably by chlorine or some chlorine compound, the gas being of a yellowish-green colour.

When admitted to hospital, "he was slightly cyanosed and had a yellowish toxic appearance." The respirations were on the average sixty, and the pulse-rate one hundred and twenty. There was some rise of temperature. The symptoms were more "toxic than bronchitic"; the cough was not very severe; he was constipated; a trace of albumin, no sugar. He died at 8 a.m. on the 4th October.

At the post-mortem: Appearance sallow, thin, inclined to emaciation; abdomen not distended; no staining of skin by gas; abdominal and chest muscles on section appeared normal.

Lungs.—Pleura adherent, both sides and base; adhesions easily broken down; no fluid in pleura; lungs appeared to be distended with marked emphysema. On section, they showed marked emphysema and particularly towards the apices; the bases were congested. There was general purulent bronchitis with marked increase of pus towards the apices. The bases were very cyanosed. The contained blood was almost black, but the coagulability was below the normal. Both lungs floated and also sections from apex and base; right lung weighed two pounds two and a half ounces; left lung, one pound ten ounces.

Trachea.—The mucous membrane was coated with muco-pus and infected, the infection increasing in intensity towards the bifurcation. There were old glands at the bifurcation.

Heart normal; no pericarditis.

Liver weighed seven and a half pounds. Gall-bladder shrunken and contained little bile; no perihepatitis; normal on section.

Spleen.—Weighed seven and a half ounces; capsule normal; slightly congested and enlarged, otherwise normal.

Kidneys.—Left weighed six and a half ounces, capsule normal, slightly congested and darkened; right weighed six ounces, capsule normal, not so congested as the left one.

Brain weighed three pounds three and a quarter ounces; no meningitis; normal on section to the naked eye.

Pancreas.—Normal.

Stomach and Intestines.—Normal.

The condition of the lungs was sufficient to account for death.

Specimens were taken of the several organs and tissues for microscopical examination.

Report on Microscopical Examination of Various Organs and Tissues, by Lieutenant D. D. Rosewarne, R.A.M.C.

(1) *Lungs.*—Sections from both showed evidence of acute emphysema and areas of partial collapse. There was intense engorgement of blood vessels but no actual hæmorrhage. Peribronchitis was well marked, but there was no sign of pneumonia. The sections also showed early pleurisy.

(2) *Mediastinal gland* congested and engorged with blood; no enlargement.

(3) *Liver.*—Section showed acute fatty degeneration, evidently not enough to account for the increase of size of the organ. No evidence of cirrhosis.

(4) *Medulla* showed only post-mortem changes.

(5) *Spleen* practically normal.

The lung condition points to acute bronchitis, probably set up by an irritant.

A NEW TYPE OF INCINERATOR.

Designed by Lieutenant HOLT.

Quartermaster, Welsh Regiment.

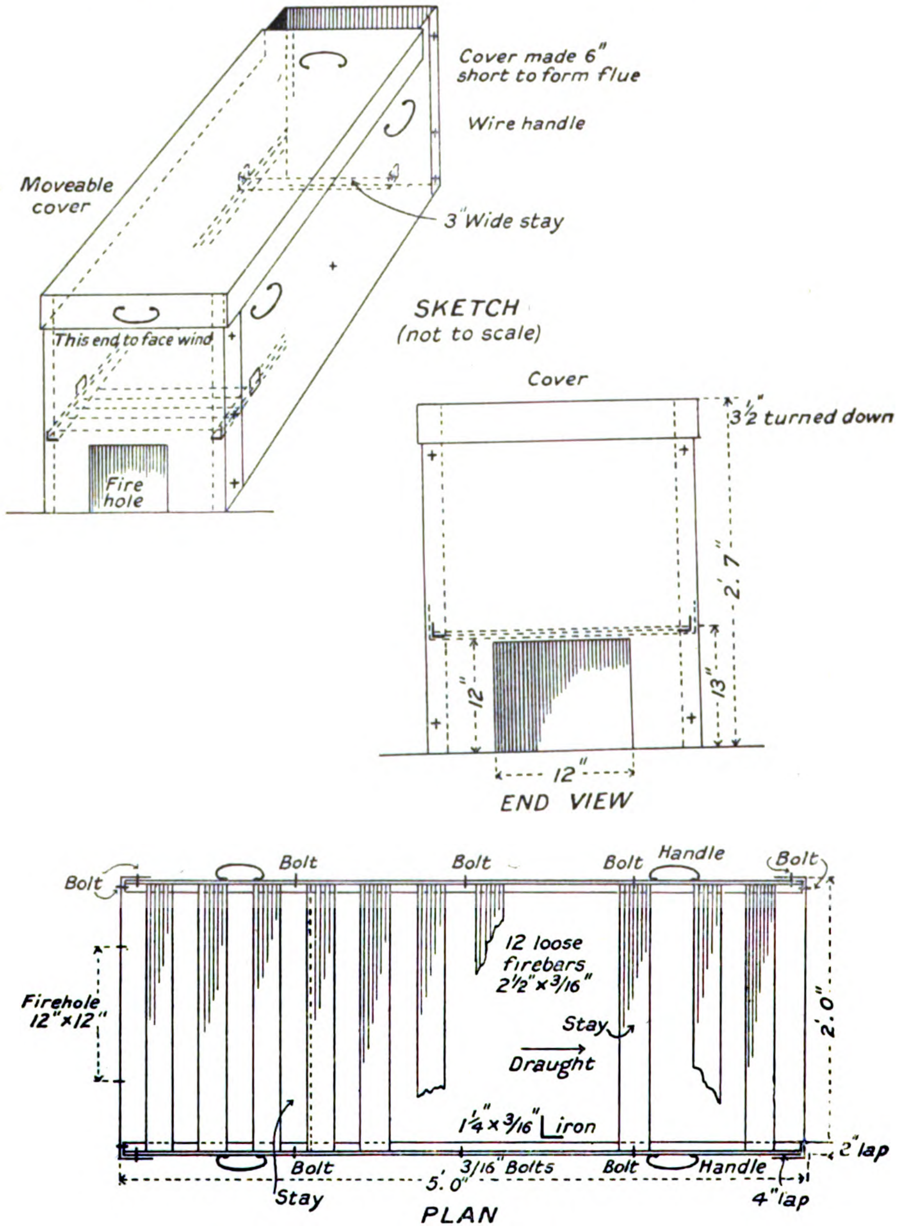
Communicated by Colonel B. WILSON.

This incinerator has been successfully used in Egypt and in India for many years, and Lieutenant Holt has now introduced it into Flanders.

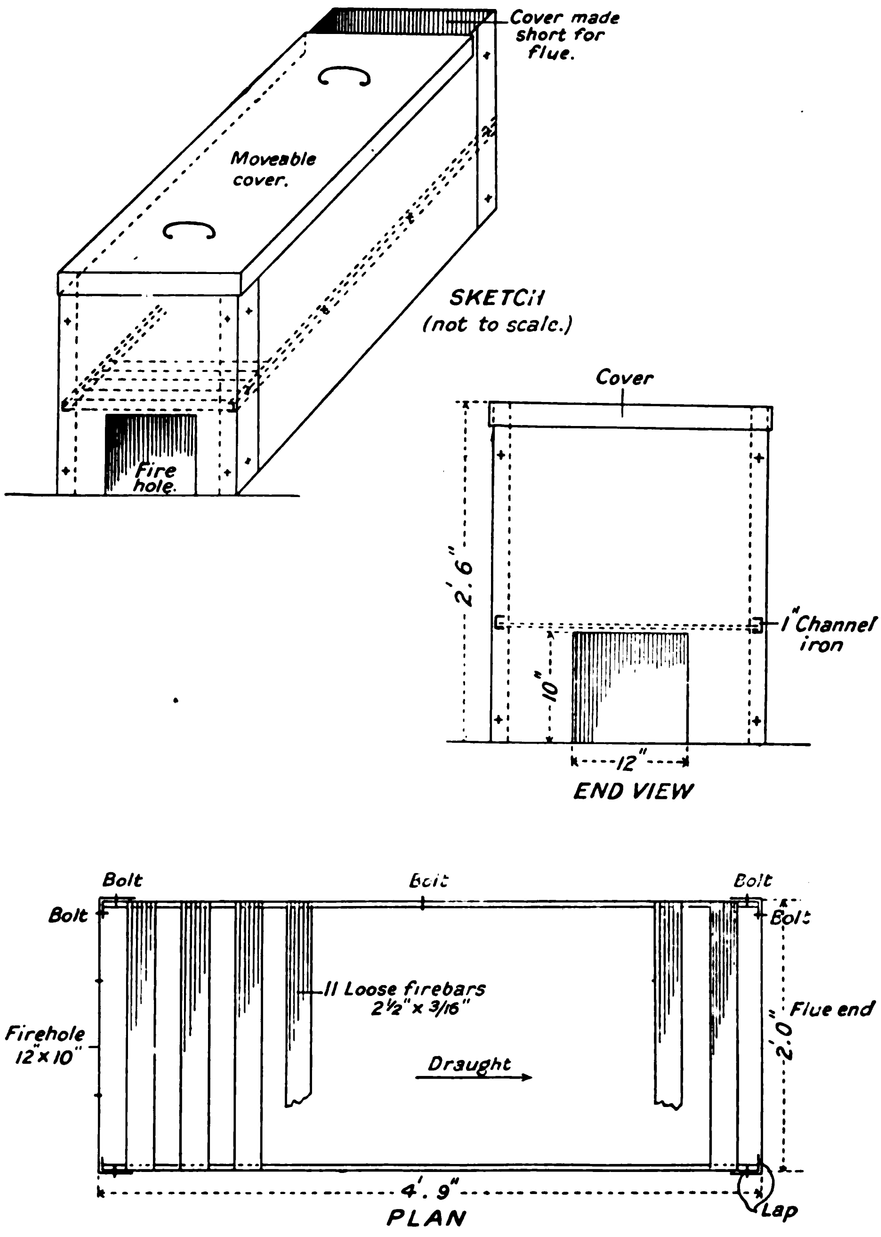
The cost of the incinerators is modest; even at the present price of sheet iron in France they have been made for about £1 apiece.

The attached drawings explain the construction of the apparatus. It is an oblong box without a bottom. It is shaped like a sarcophagus and built of sheet iron bolted together with rivets and nuts. A grid is made by riveting a length of "channel" or T-iron along the sides in the long axis of the box about one-third of the way up from the bottom. These irons support the bars which form the grid as shown in the sketch. The bars can either be riveted in or left loose for transport. At one end an aperture is cut to admit draught and allow of raking out ashes. The cover is made short, about two inches or three inches shorter than the box, so as to form a flue at the top and opposite end of the box from the firehole.

IMPROVED TYPE. SCALE: 1 INCH TO 1 FOOT. CONSTRUCTED OF SHEET IRON IN 5-FEET 4-INCH BY 2-FEET 7-INCH SHEETS, 9 KILOS EACH (APPROX. 22 BWG.).



ORIGINAL TYPE. SCALE: 1 INCH TO 1 FOOT. CONSTRUCTED OF FLATTENED CORRUGATED SHEETS.



The apparatus is used as follows :—

A layer of some inflammable material, such as old billeting straw or dry horse litter, is laid on the grid and lighted. The fæces from latrine buckets are now emptied in, more dry fuel put on top and the lid adjusted. The apparatus is always filled from the top by simply lifting the lid.

The incinerator is placed on the ground with its long axis in the direction of the prevailing wind. That is, the firehole should be turned towards the prevailing wind. It is loaded up and lighted, and continues to burn with practically no attention until the load is consumed. It can then be loaded up again. An attendant of moderate intelligence visiting the incinerator twice or thrice in twenty-four hours can keep it going. It is as nearly foolproof as anything in this world ever gets to be. The one first made by Lieutenant Holt consumed the rubbish as well as the fæces of about two hundred and fifty men for about seven months.

Report.

FULHAM MILITARY HOSPITAL.

THE medical staff of this hospital have instituted regular fortnightly meetings for the discussion of cases. Three meetings have been held up to this date. At the last meeting on December 21, 1915, Major Parsons, Officer Commanding, being in the chair, three interesting cases of heart disease were shown by Lieutenant Cummings. Of these, the first was a case of aneurysm of the arch of the aorta due, apparently, to violent concussion by an exploding shell, the symptoms developing immediately after the concussion and there being no history of syphilis. The discussion centred round the question of the production of such a traumatic aneurysm. Dr. Carnegie Dickson, Pathologist; Dr. McNair Wilson, Cardiologist; Dr. Stoney, Radiographer; Lieutenant Lee, Lieutenant Gray, Dr. Kinnier Wilson, Neurologist, Dr. Harrison, Mr. Chapple, and Major Parsons taking part in the discussion.

The second was a case of auricular flutter supervening on the stress of military service. There was, however, a suggestive history of several attacks of sudden unconsciousness previous to enlistment.

The third was a case of pericarditis and aortic valvular disease with enormous enlargement of the heart in which great improvement had followed the use of thyroid gland medication. The signs of hypothyroidism were very slight but of the usual character.

These cases gave rise to some discussion of, what is coming to be known as, the "Soldier's heart." It was suggested that at a later

meeting a fuller discussion of such cases, of which there are many examples at present in hospital, should be arranged for.

Mr. Chapple then showed two cases of spiral fractures in the lower third of the tibia. In both the same deformity of marked eversion of the foot was present after union had taken place, but in one a subsequent replacement of the bone and plating had resulted in a good position and a useful foot. Mr. Chapple was of opinion that the ordinary treatment of such fractures was always unsuccessful, and advocated operation in every case possible, but he reminded those present that in septic compound fractures it was necessary to wait for long after the wound was completely healed before attempting any surgical interference.

The last case, one of considerable neurological interest, was shown by Dr. Gay. The patient gave a history of attacks of vertigo, vomiting and abdominal pain extending over four years, and since admission to hospital he had developed nystagmus and a tendency to fall backwards. The vertigo was of the intracerebellar type, i.e., he had a sense of rotation, external objects appearing to move in the same direction. Examination showed the presence of diminished abdominal reflexes. Dr. Nourse, Otologist to the hospital, after examination, had pronounced against labyrinthine disease. In a very illuminating review of the case, Dr. Kinnier Wilson, Neurologist to the hospital, gave grounds for the belief that no one lesion would explain both the nystagmus and the diminution in the abdominal reflexes and stated his opinion that the case was probably one of early insular sclerosis.

The fourth clinical meeting of the staff of this hospital took place on Tuesday, January 11, 1916. Major Parsons, Officer Commanding, in the chair.

Dr. Belfrage opened a discussion on septic compound fractures due to gun-shot wounds. He outlined the chief indications for treatment as being: (1) Vigorous treatment of the sepsis; (2) the securing of comfort to the patient and ease of nursing; (3) early movement of the joints; (4) correction of deformity. He had found the ordinary splints of little use and anticipated much help from Hey Grove's modification of Hodgen. He emphasized the desirability of paying more attention to obtaining a useful limb than to accurate apposition of the fragments. It was doubtful whether extension could be usefully employed in the early stages; later on the fragments could be adjusted under an anæsthetic.

Mr. Chapple pointed out a fundamental difference in the treatment of fractures of the upper and lower extremities. In the arm the exact position of the fragments was often not of vital importance in the securing of a useful limb; but in the leg the necessity of parallelism for walking dictated the greatest care as to their position. He advocated operation where the disturbance of the fragments rendered it necessary, but in

septic cases it was essential to wait until the sepsis had been dealt with before attempting plating. He also referred to a great truth established by Sir Arbuthnot Lane, that in dealing with a much comminuted fracture it was not necessary to get the whole circumference of the ends approximated. If a small portion were put in apposition, the gap would be filled by new bone laid down, if the after-treatment were suitable.

Mr. Lee said that generally there was too much haste to remove sequestra. They should be left till complete separation occurred, as frequently an apparent sequestrum proved to be a focus of new bone formation. He wished to emphasize the importance of the treatment of sepsis, of leaving, or if need be making, a very widely open wound, and that meantime the surgeon should not be too anxious about the displacement of the fragments.

Dr. Dickson, Pathologist, referred to the extreme rapidity with which cancellous tissue can be absorbed to make room for active marrow in acute general diseases, and with regard to the question of the duration of a septic focus, referred to a case in which a projectile had been removed six months after complete healing, but in which at the operation pus was found containing organisms of feeble vitality, but still capable of growth.

Dr. Kinnier Wilson, in discussing after-results, expressed the opinion that in some cases the disability of muscular movement was greater than could be explained by mere disuse. He considered that some cases were explicable on the theory that a defect was present in the reflex arc through the spinal cord. Possibly the constant afferent impulses from the diseased focus produced a dynamic functional change in the anterior horn cells and consequent muscular atrophy. Electrical treatment in such cases was more important than massage. Repeated efforts on the part of the patient sometimes sufficed to reawake innervation through the reflex arc.

Major Parsons dwelt on the debt the surgeon owed to X-rays and advocated putting up fractures under X-ray illumination. He was more inclined to the use of splinting than some speakers, as he considered the prevention of movement in the injured tissues was of great value in limiting sepsis. The joint involved in a septic process required immobilization, while the other joints required to be moved. He considered continuous extension valuable and that often the weight applied was too small; attempts should be made from the first to rectify deformities. With regard to the all-important point of treating sepsis, he referred to the value of transverse incisions, which tended to remain gaping. The introduction of solid sodium chloride which had given good results in France should be tried, as also the introduction of solid urea, on which Professor Symmers, of Belfast, had reported favourably. He had obtained good results in septic conditions by Bier's treatment before the War and thought greater use might be made of it.

THIRTIETH GENERAL HOSPITAL, PALERMO.

REPORT OF THE FIRST MEETING OF THE MEDICAL SOCIETY INAUGURATED BY THE OFFICERS OF THE HOSPITAL NOW STATIONED AT PALERMO.

THE War has necessitated the presence of a fair number of British medical men in Palermo, and the feeling was naturally expressed that some effort should be made to hold regular meetings at which matters of interest, both clinical and otherwise, could be discussed. It was, therefore, decided to form a Medical Society which should be open to any British medical men who might find themselves for the time being quartered in the neighbourhood. The first meeting was held on Monday, January 3, and a very good attendance was secured. The officers elected were: President, Lieutenant-Colonel McNaught; Vice-President, Major Gater, and Hon. Secretary, Lieutenant Almond. A paper was read on "Mediterranean Fever," a disease fraught with special interest just now owing to the large number of medical men at present doing duty with the Forces in various parts of the Mediterranean. The subject was very ably dealt with by the President, who after touching on the history and ætiology of the disease recounted many interesting points from the work of the Commission which eventually led to the discovery that the infection was communicated through goat's milk. After dealing fully with the differential diagnosis and treatment, discussion was invited. Many of those present joined in the discussion and a number of questions were asked. A very interesting case was cited by Major Bardswell which had come under his care as a case of tuberculosis, but which proved on examination of the blood to be one of Mediterranean fever. Much additional interest was lent to the subject by the knowledge that the President spoke as an authority on the disease, as he was a member of the Commission which sat to investigate the disease in the year 1906. A successful meeting terminated with a tribute to the general excellence of the paper.

It is intended to hold meetings once a week, and the subjects for the next two papers are "The Dysenteries" and "Liver Abscess."

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Translation.

FLY DESTRUCTION BY SPECIAL ARRANGEMENT OF MANURE HEAPS.[1]

By Professor R. BLANCHARD.

We have seen (*in previous articles*) that certain regulations have been made in several towns in the United States in respect of dunghills. These regulations are based on recent discoveries in the life-history of the fly and may require subsequent amendment, although during the past two years the question of the dunghill has been attacked in such a practical manner that we may consider it as settled.

In 1913 two medical men, Drs. E. C. Levy and W. T. Tuck, of Richmond, Va., established the fact that the fly larvæ before reaching the nymphal stage carry out a migration with a view to finding a suitable nidus in which to undergo their transformation. Hence they aim at leaving the dungheap in order to bury themselves in the ground. The authors in question very properly looked on this discovery as indicating a practical means of destroying the larvæ. This consists in placing the dunghill on a grid standing over a shallow trough filled with water. Working their way to the periphery, the larvæ reach the sides or bottom of the dungheap and tumble into the water, and are there drowned.

The scheme, once promulgated, appeared likely to give excellent results, and experiments were made on these lines at entomological stations in various countries. Especial mention may be made of the researches of Levy and Tuck, of C. G. Hewitt in Canada, of those of R. H. Hutchinson, at Arlington, Va., and of those made at the Agricultural Colleges at Maryland and at New Orleans. The various investigators all arrived at concordant results, which make it perfectly clear that this new method is of great practical importance. I should say, however, that the *novelty* of the method lies in its hitherto unlooked-for biological results (*i.e.*, the destruction of flies), and that it is in some respects merely a modification of methods already devised in France by Dehérain and Ringelmann for preventing the loss of ammonia and nitrogen from dungheaps.

Flies lay their eggs in the bedding of byres or stables, or perhaps on the manure when it has left the stable. In either case the larvæ ultimately reach the superficial layers of the dungheaps, where the atmospheric oxygen can penetrate without difficulty. In good conditions of air and nourishment their evolution proceeds rapidly; at the end of ten to fourteen days the mature insects escape and fly away.

Meanwhile, new layers of bedding are added daily to the heap, and

[1] Extract from "La Lutte contre la Mouche."

these contain, or subsequently receive, new relays of eggs. The dunghill thus acts as a nidus where the reproduction of flies flourishes apace; hundreds and thousands escape daily, while at the same time generation after generation of larvæ appear, to replace a hundredfold the forbears who have preceded them.

The dungheap is also the seat of active fermentation, due to anaerobic organisms. There are formed carbonic acid and other gases, irrespirable even by a maggot, which is not over-exacting as to the composition of the atmosphere in which it lives. After a while the oxygen is completely used up and fermentation raises the temperature of the heap. Hence the larvæ quit the central parts, where fermentation is most active, and make tracks for the bottom or sides of the heap. They dislike light, so they remain dormant some little distance from the outside during the day, but if the heap is examined at night it may be observed that they escape at the sides and, falling on the ground, bury themselves therein. They beat a particularly rapid retreat from those parts of the heap where, in order to encourage the movements referred to above, a certain amount of moisture is added. Nothing is easier than to bring about these conditions. The liquid manure pump which, as a result of the work of the French agriculturalists referred to above, is to be found in all well-regulated farms, answers the purpose admirably.

Such, in broad outline, are the conditions which must be brought about in order to be sure of destroying flies wholesale on the American plans. Now as to their practical application (fig. 1).

A rectangular trough is constructed of concrete, 4 inches deep, 22 feet long and 12 feet wide. In the receptacle thus formed a platform is constructed in the form of a grid, such as may sometimes be seen in shower baths. This platform must be shorter and narrower than the trough over which it rests. It is supported by wooden uprights fixed in the bottom of the trough. In one of the sides of the latter is an orifice allowing any liquids to flow from the trough to a neighbouring cistern, also made of concrete, and measuring 5 feet by 6 feet 6 inches by 4 feet deep. A manure pump is fixed in this cistern.

The plant is then ready to be put into use. Manure is brought up from the stable or byre and daily additions form new layers. For the first few days the new deposits are watered. The water penetrates through them and falls into the trough, which presently becomes full and is emptied into the cistern. A certain amount of liquid, however, must always be left in the trough, else the larvæ will manage to climb the walls and escape. Disappointment will also follow if there is any neglect in removing débris of all kinds, such as straw droppings and particles of manure which may fall from the heap. When the cistern contains a certain amount of liquid manure it is no longer necessary to water the heap; instead it is doused with the liquid manure by means of the pump, and this aids fermentation processes in the heap. We may say at once,

without labouring a point which has already been threshed out by French agriculturalists, that the wetting of the heap has the additional effect of setting the larvæ on the go, for they endeavour to get away from such parts of the heap as they find too damp.

By whatever route they reach the periphery, the larvæ make the fatal plunge into the trough and there are drowned. Ultimately the corpses are drawn off into the cistern, where they accumulate in a truly surprising manner. Hutchinson computed that between June 25 and October 1 their number reached 112,000. But this falls far short of the total number, for during the time in question a flock of young turkeys was reared in the field and paid constant visits to the tank in order to feast themselves on the larvæ, which they did with avidity. After October 1 the manure on the platform was examined with scrupulous care —so to speak, straw by straw—in order to find out the number of pupæ that it still contained. There were only 1,500 discovered; out of a total of 113,500, therefore, more than 120,000 had been destroyed; only 1,500 would have succeeded in reaching the stage of the adult fly. This gives us the remarkable proportion of 98·5 per cent destroyed, and this not as the result of chance or of specially favourable circumstances, for the proportion tallied exactly with that found by other investigators.

As regards fermentation changes and the manurial qualities of the dunghill, this method is free from drawback; indeed, it improves the quality of the manure, since it favours anaerobiosis and prevents loss of nitrogen. The only reasonable objection to it is that the trough and cistern, being full of stagnant water, form a suitable nidus for the development of mosquitoes. But in order to counteract this it is only necessary to pour a little paraffin over the surface (say ½ oz. to ¾ oz. for every square yard of surface) in order entirely to prevent the incubation of these dangerous insects; of course, the cistern also will have a wooden cover.

In the neighbourhood where these experiments were carried out, some attempt was made to estimate their effect upon the number of flies occurring in kitchens and stables. The mean of ten counts of flies caught in the kitchen was 2,131 before August 10, and 692 after this date. Nine enumerations in the stable gave an average of 1,038 before August 10, and of 248 after this date. The reduction in flies was therefore 67·5 per cent in the kitchen and 76 per cent in the stables. These figures are not altogether satisfactory when compared with the results of the experiment, but it must not be forgotten that a winged insect like the fly has a considerable radius of flight, perhaps several hundred yards, especially when it is attracted by the odour of substances from which it can derive nourishment or in which it can deposit its eggs. Thus flies from surrounding areas will, we think to quite a considerable extent, take the place of those which have been exterminated. In fine, although this new method is absolutely efficacious, it cannot give really good results

unless its adoption is general in the district, whether town, village or countryside. It is foredoomed to failure if it is only carried out by some pioneer whose neighbours persist in following the ancient and evil tenor of their ways.

Local authorities (*les pouvoirs publics*) have sufficient powers to insist on its immediate and general adoption, and what a boon it would be to make our towns and villages hygienic! All that is necessary is to make by-laws (*promulguer l'ordre*) insisting on the removal of dunghills and on their reconstruction on the American plan at a stated minimum

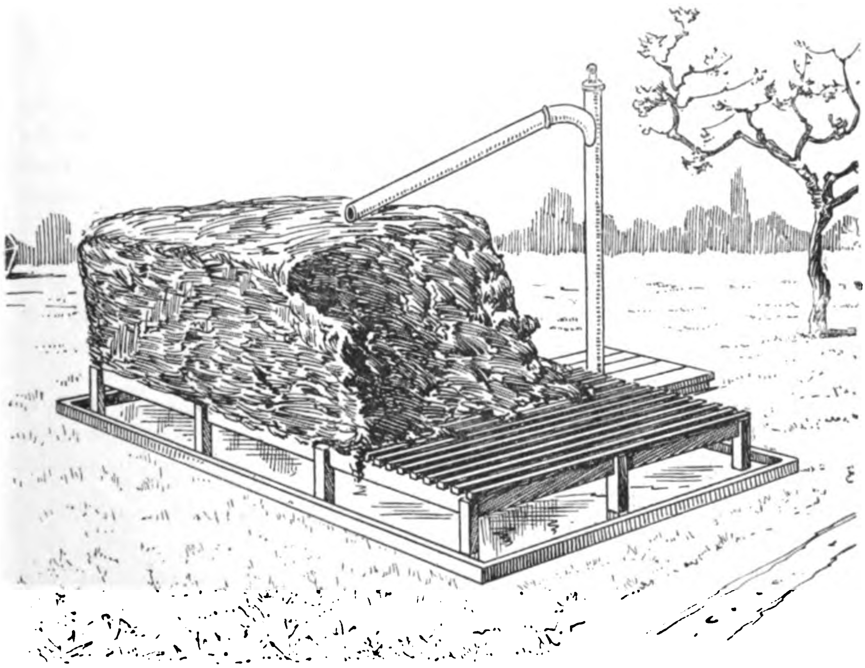

Fig. 1.

distance from dwellings, stables, cowsheds, and pigsties, and lo! like that of a painted butterfly bursting from its dull chrysalis, a transformation would take place. Our lovely villages of Lorraine, for instance, now vilely contaminated by the huge and stinking dungheaps which we see so often piled up against the walls of the very houses themselves, would be purified. Nowhere else in the fair fields of France have I seen so revolting, so insanitary and so reprehensible a custom. The air so reeked with ammoniacal fumes that when I visited these villages I actually experienced a definite smarting of the nasal and conjunctival mucous membranes.

Cannot some law, decree or restriction rid us of these blots? Cannot someone be found who will make short work of the Augean stables, and put an end to the leaking ditches of farmyard sewage which contaminate our wells and water supplies and give rise to so many deadly epidemics? In these times of war in which we live, a wise military authority has in many districts got rid of these villainous dunghills. Let us see that when peace is established the evil does not recur and that dunghills are made on approved lines, especially in those districts which are undergoing reconstruction. Regulations should embrace not only collections of houses, but also isolated farms. Our aim is the destruction of the fly and we must take whatever steps are necessary. No more favourable time could be found for the issuing of those regulations which we look to the local authorities to frame.

The dunghills and their cisterns should be a reasonable distance from dwellings or stables, on account of the smells they emit and of the attraction they exercise for the fly. Fig. 1 shows the general appearance of one of them. It is a perspective drawing from the measurements given above, those adopted by Hutchinson. It need scarcely be said that there is no mystic significance in these particular measurements—any size that is convenient may be adopted, only it is essential not to make the heap itself more than 5 feet 6 inches deep, otherwise the larvæ will have too far to travel to make quite sure of their falling into the trough where their destiny awaits them.

The technical details of construction are set out precisely and at some length by Mr. H. G. Richter, Secretary of the Ligue Sanitaire Française, in a note, illustrated by two plans, which forms a pendant to this article.

Plant for the Destruction of Fly Larvæ in Dunghills.

By Henry G. Richter.

The two figures appended will make clear the essentials of the plant which we are about to describe. It consists of four distinct elements:—

(1) *A wooden grid* (AB) on which the manure is deposited; this platform is placed on—

(2) *A concrete base* (CD), destined to receive the manurial drainage.

(3) *A covered cistern* (E), in which the drainage is collected.

(4) *A hand pump* (F) fixed in the cistern and serving to distribute the drainage over the dungheap.

This particular plant is designed to deal with 40 cubic yards of manure. We give in round numbers the dimensions of the platform used by Hutchinson in his experiments; of course, anyone can alter the dimensions to suit his particular needs.

(1) *The Grid.*—Any kind of wood may be used, but such oak as is found locally is preferable. The platform should be 20 feet by 10 feet, and is supported by six supports (G), each 4 inches square and 1 foot

8 inches high. The supports are fixed to four joists (H), which form the framework of the platform and measure 6 inches in depth by 1½ inches in thickness. Two of the joists are 10 feet long and form the short ends of the framework. The others are 20 feet long and form the sides.

On this framework is fastened the grid, composed of laths 10 feet long, 1½ inches deep and 1½ inches wide. These are nailed across the framework parallel to each other and an inch apart.

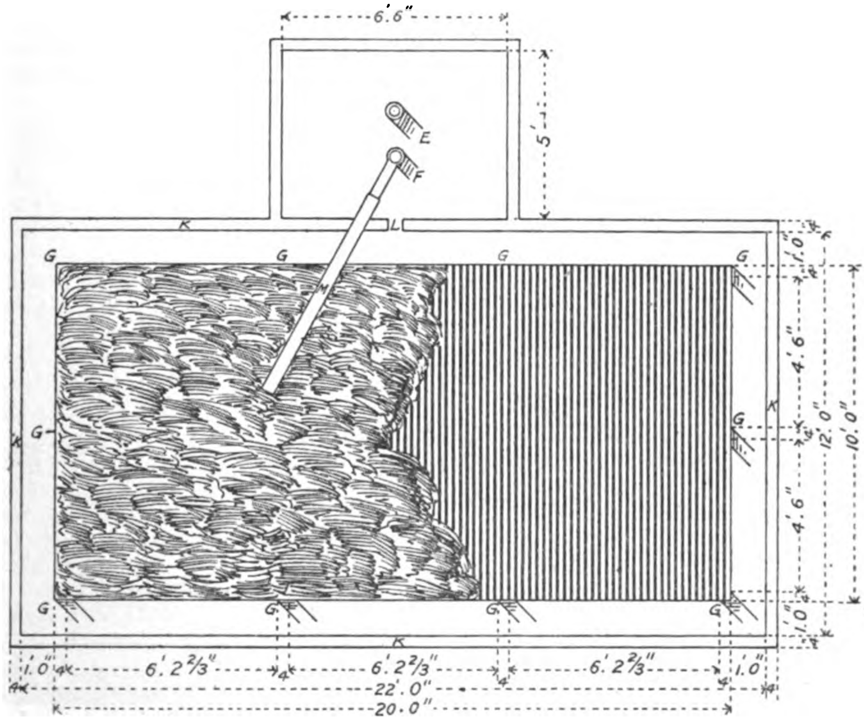

Fig. 2.

(2) *The Concrete Base.*—This has an internal measurement of 22 feet by 12 feet. All round the base is a rim (K) 4 inches high and of the same thickness. This forms a trough, which receives the drainage from the manure. There should be a slope in the direction of the cistern to speed the flow thereto. An overflow pipe (L) is arranged at the level of the platform and communicates with the cistern. It is plugged with a wooden bung, which can be removed when it is desired to empty the trough.

(3) *The Cistern.*—Opposite the middle of one of the longer sides of the trough is a cistern measuring 5 feet by 6 feet 6 inches, and 4 feet

deep. It is constructed of concrete 4 inches thick and is covered with an oak cover.

(4) *The Pump.*—An ordinary hand pump may be used to pump the drainage liquid from the cistern and to distribute it by means of a pipe (M) over the heap.

It is difficult to state the precise cost, for this will vary in different places. In any case it will be small in comparison with the great advantages gained.

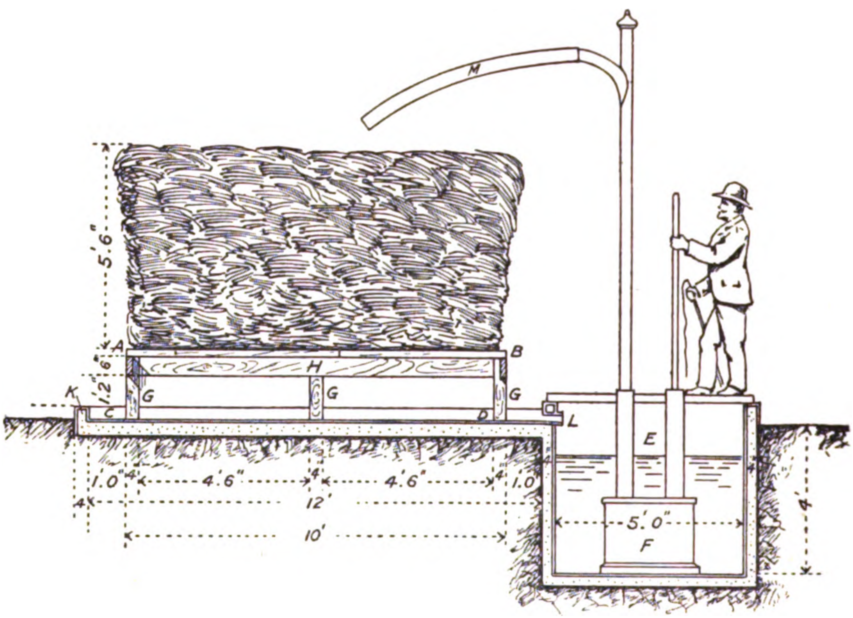

FIG. 3.

The plant can be constructed by unskilled labour. It is so simple that it is quite unnecessary to employ a builder.

If the scheme is to be carried out on a somewhat larger scale, it is a good plan to build a second platform similar to the first, parallel to it and on the opposite side of the cistern. The pump can then be used for watering both heaps.

The platform just described has an area of 200 square feet. For the successful destruction of fly larvæ the heap should not exceed 5 feet 6 inches in depth. This will allow of about 40 cubic yards of manure being put on the platform.

Reviews.

Exercise in Education and Medicine. By R. Tait McKenzie, B.A., M.D. London: W. B. Saunders Company. 1915. Second edition. Pp. 585. Illustrations, 478. Price 18s. net.

Medical men are fully alive to the importance of physical exercise for the promotion of health and for the proper development of the growing individual, and an increasing number are accustomed to prescribe graduated exercises and other forms of mechanical treatment for various morbid conditions. The knowledge of most men on this subject is however generally scanty. The subject is not taught in the medical schools of this country and the practitioner is compelled to trust blindly to the masseur whom he employs for administration of the treatment, or has to improvise for himself methods which have been already worked out and improved as the result of experience. Many men have felt the need of some book written by a medical man with experience in such matters, which would tell them exactly what sort of exercises are best adapted for particular cases, and especially what are the dangers to be avoided.

This need is fully met by Dr. McKenzie's book. The author, a medical man, is Professor of Physical Education in the University of Pennsylvania, and is well acquainted with the physiological aspects of his subject, as well as with the use of exercise as a therapeutic measure. The work is divided into two parts. In the first half the author deals fully with the part exercise should play in a full course of education. He describes the different systems which have been devised in various countries and gives an interesting account of the measures which are being taken to remedy the pernicious influence of modern city life on growth by means of play and exercise.

The second half of the work is devoted to the use of exercise and massage as remedial agencies. In this part the author draws on his own rich experience. The whole treatment of the subject is very sane, and such as to be of the greatest assistance to practitioners. Different chapters deal with the use of exercise and mechanical treatment in physical deformities, respiratory and circulatory diseases, hernia, obesity, and nervous diseases (including chorea and locomotor ataxia). With this book to guide them, medical men will have less excuse to treat by pill and draught conditions really due to bad living, and curable by a proper development and use of the muscular formation of the body.

The book is to be strongly recommended. E. H. S.

Syphilology and Venereal Disease. By C. F. Marshall, M.D., M.Sc., F.R.C.S. London: Baillière, Tindall and Cox. Third Edition. 1914. Pp. x and 465. Price 10s. 6d. net.

This is the third edition of the book since 1906, but it is regretted that it has not been brought sufficiently up to date, considering the large amount of important work that has been accomplished in the meantime.

The amount of material it contains is sufficient to give a general knowledge of syphilis and gonorrhœa, but is disappointing to students of this important subject. The author is not convincing as to the value of salvarsan and neo-salvarsan in the treatment and cure of syphilis, and it is evident that he has had little or no experience in the use of these drugs. The book is devoid of illustrations, and lacking in sufficient details regarding treatment. It is, however, worthy of perusal, as the material it contains is good and well put together. E. G. F.

The Biology and Treatment of Venereal Diseases. By J. E. R. McDonagh, F.R.C.S. London: Harrison and Sons. 1915. Pp. viii and 625. Price 25s. net.

The author's investigations have led him to believe that the *Spirochæta pallida* is not the cause of syphilis, but that the spore of the parasite is the true cause of the symptoms. He maintains that the *S. pallida* is only the male gamete of the life-cycle of an organism which he has named the *Leucocytozoon syphilidis*. Mr. McDonagh presents a strong case for careful thought by all those who are interested in this important subject. The various chapters on Syphilis are quite complete, and from a clinical point of view excellent. Believing that the leucocytozoon is the cause of the symptoms, the author's views as to prognosis and treatment are confined to the spore. Other observers have described the development and changes in the *S. pallida*, and Ross did so as recently as 1912. Many interesting points have been presented as to the mode in which syphilis attacks the central nervous system, but it is regretted that the author is not enthusiastic in the treatment of nervous lesions by intrathecal injections of salvarsanized serum. During a stay of several months in New York the writer has seen very satisfactory results in early cases of locomotor ataxia obtained by Drs. Swift and Ellis, at the Rockefeller Institute of that city. Mr. McDonagh does not believe that salvarsan and neo-salvarsan are of any use in the treatment of congenital syphilis in children, but in my experience it is a very valuable remedy in infants and children, and may be safely administered *per rectum* by means of a soft rubber catheter and glass container. Neo-salvarsan is preferable, and no after-effects are noticeable if the doses are carefully regulated as to weight and age.

The chapter on Gonorrhœa is good, but it is regretted that the author has so poor an opinion of the urethoscope as an aid to diagnosis and treatment. In the hands of many surgeons this instrument is known to be invaluable in obstinate cases, such as papillomatous growths or cysts, etc., in the region of the verumontanum, as well as lesions in other parts of the urethra. Without the aid of such an instrument it is very often impossible to tell the cause of a gleety discharge, and one might grope in the dark for many months or years. The prominence given to the use of vaccine in gonorrhœa is sound advice, and I believe will be largely carried out in the future. A great many cases that have come under the author's treatment are described and the various types of primary sore are illustrated by coloured plates. The book is beautifully illustrated throughout.

The chapters on soft sores are good, and are also splendidly illustrated. The second part of the book deals with the cells which take part in chronic inflammation, and the relationship between chronic inflam-

mation and malignant disease. This makes very interesting reading on account of the original ideas expressed. There is little doubt that Mr. McDonagh's views on the life-history of the parasite of syphilis will create a great deal of controversy among protozoologists. The book may be confidently recommended as one of the best works on venereal diseases and deserves to be in the hands of all syphilologists as well as general practitioners.

E. G. F.

Correspondence.

GASTRIC JUICE AND THE PREVENTION OF ENTERIC FEVER AND CHOLERA.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I have just read with the greatest possible interest Lieutenant-Colonel N. Faichnie's eminently sound rules for drinking water, which appear in the September issue of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS. His belief that enteric and cholera bacilli are killed by gastric juice is one that I have myself long held.

If gastric juice can digest the albuminous or protein contents of food when a sufficient amount of juice is present in the stomach, surely it ought also to be equal to the task of digesting enteric, cholera and other bacilli, which after all are nothing but masses of albumen or protein.

That both officers and men frequently render themselves liable to contract disease by eating under conditions which make it impossible for an adequate secretion of gastric juice to take place, and that this fault can be easily remedied will be obvious later, when I formulate rules of eating that I have myself followed for over nine years—on manœuvres, hunting, shooting, and in cantonments—with nothing but the greatest benefit to my health.

Pawlow's gastric experiments prove that mechanical stimulation, that is, the mere act of putting food into the stomach, does not constitute an effective excitant of the gastric glands. A passionate longing for food—psychic stimulation—and the satisfaction of thoroughly enjoying it, is necessary for the most intense activity of the gastric glands.

The following rules, therefore, may safely be laid down:—

(1) Never eat hurriedly, but take time to masticate food very thoroughly, and get all the taste you can from each mouthful of hard, soft or liquid food before swallowing it.

Attention to the act of eating and appreciation of the taste are necessary to excite a flow of gastric juice into the stomach to meet the food—as demonstrated by Pawlow.

(2) Never on any account eat unless honestly hungry and you can thoroughly enjoy eating the food available at the time.

It is by no means necessary, however, to eat the moment one feels hungry. Suppose for any reason it is not convenient to eat then, it cannot harm one to do what people frequently do when occupied with some keenly interesting work, namely, ignore the fact that you are hungry and satisfy your appetite at the next meal.

Whilst it may hurt one's feelings to have to miss a meal, it cannot possibly hurt the body. For the system can keep itself going in a remarkable manner by drawing upon the reserve of food, fat, glycogen, etc., which is stored under the skin, in the muscles and other organs of all of us, except those who are practically living skeletons. Surely Nature enables us to store up a reserve of food in the body in order that we may make use of it when needed. We have to call upon our reserve in times of sickness, and there is no logical reason why we should not do so, occasionally, when in health.

(3) Never eat when fatigued or exhausted, as appetite is not then present. Wait until rested before taking food. Remember that appetite is the first and mightiest exciter of the secretory nerves of the stomach. Therefore there is more than a grain of truth in the old adage, "Good digestion waits upon appetite." Food taken when not hungry remains in the stomach longer than necessary, and is liable to undergo decomposition and set up digestive disturbances, etc. Again, remember that fatigue or exhaustion is due to fatigue toxins, which require removal from the system, and that rest is the cure for fatigue. It is true, food often gets the credit for removing the feeling of tiredness following exertion, whilst in reality the return of strength in these cases is due to the rest obtained by sitting down to the meal. It certainly could not have been *that* meal which restored our energies, for we cannot live upon the food just taken; there was no time for it to be digested and assimilated. We live upon what we have digested and assimilated at some previous meal.

(4) Never eat whilst the mind is distracted by anxiety of any sort. If worried or angry do not attempt to take nourishment until the stress of the excitement has passed. Grief or excitement causes a stoppage in the flow of gastric juice. Moreover, a mind centred on troubles cannot give itself up to that thorough enjoyment of the act of eating which is so necessary for a vigorous flow of gastric juice.

In conclusion, I may add that the above rules for eating were given by me in a lecture which formed part of a course of instruction on sanitation and personal hygiene which I was detailed to deliver to the officers of the Chatham garrison in the winter of 1908.

I am, etc.,

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AN INVESTIGATION OF ACUTE NEPHRITIS: THE SO-CALLED "TRENCH NEPHRITIS."

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CONTENTS.

I.—INTRODUCTION.

The observations recorded in this paper have been carried out at St. Bartholomew's Hospital for the Medical Research Committee, who made all the arrangements for the cases placed at my disposal, and defrayed the expenses connected with this work. The cases referred to in this paper were mainly under the care of Captain Langdon Brown, and his report[1] upon the clinical aspects of the disease in question has already appeared in this Journal. The following account represents the work done by the writer on this subject up to the present date, and it has been thought advisable to publish these details to indicate the lines along which the pathological investigations have tended to develop. So far very few observations have been made on these cases of nephritis, but from the clinical point of view the work of Abercrombie[2] seems to provide confirmatory evidence of the claims made by Langdon Brown. The subject has been attacked from many different points of view by my colleagues in the Pathological Department of this Hospital, and a complete account of this combined and co-ordinated work will be published later. Attention here has been paid more particularly to the variations in the diastatic activity of the urine as an index of renal function, the extent of tubular damage, and the rate of recovery. The possible origin of the disease has also been considered from two points of view, namely, the question of a co-existent intestinal toxæmia, or a general toxæmia, whether of mineral or parasitic origin.

II.—THE CHEMICAL CHANGES OBSERVED IN THE URINE AND THEIR VALUE AS AN INDEX OF RENAL FUNCTION.

(*a*) The Diastatic Activity of the Urine as an Index of Renal Function.

This work has been based almost entirely upon a previous investigation carried out at St. Bartholomew's Hospital during the past two years, and not yet published. The diastatic activity of the urine in the various forms of albuminuria has been determined by a modification of Wohlgemuth's method. The principle of the method depends upon the presence of the ferment diastase in every urine and its power of splitting up starch into dextrin and maltose. A solution of starch of known strength is added to varying quantities

[1] Langdon Brown, Journal of the Royal Army Medical Corps, 1915, xxv, 75.
[2] Abercrombie, *Brit. Med. Journ.*, 1915, ii, 581.

of the urine ranging from 1 c.c. down to 0·009 c.c. and the mixtures incubated at 29° C. for exactly half an hour. The processes of digestion of the starch solution are then determined by the addition of the same quantity of a standard solution of iodine to each tube. The stage at which the starch has been digested as far as the dextrins is indicated by a deep red colour and this is taken as the reading. This reading in a normal person is usually in the tube containing 0·2 c.c. of urine. All the tubes below this are either mauve coloured or deep blue. The results are expressed in units of 1 c.c. capable of digesting 2 c.c. of the 0·1 per cent starch solution used. The average values for a normal healthy person by this method range between 10 and 22·2 units. All cases of nephritis, whether of the acute, chronic interstitial, or parenchymatous type, give generally much lower values, usually below five units.

In cardiac diseases, on the other hand, normal values are met with, except at times when there is lack of compensation, and then low readings are obtained. Apart from this I have not met with any other disease where low values prevail for the diastatic activity of urine. In passing, it may be noted that the various toxic kidneys, such as are met with in albuminuria of pregnancy, eclampsia, hyperemesis gravidarum, and where very large quantities of albumen are excreted in the urine, give very high readings for diastases. This is in striking contrast to the results met with in nephritis, and points, I think, to a lesion of the pancreas in such conditions. The diastatic activity of the urine in cases of pancreatic disease shows very high values ranging from 100 to 1,000 units, and this estimation is now regarded as a valuable aid to the clinical diagnosis of affections of this organ.

The appended table gives in detail the observations made upon the cases of acute nephritis, the estimation of the diastatic activity being carried out on more than one occasion in most of the cases.

In all, 50 cases have been examined, and the results show that the diastase values were below normal in 31 instances, giving a percentage of 62. The remaining 19 cases giving normal values were all convalescent, and many showed no albuminuria, or only faint traces. In no case was a high diastase value found amongst the whole series, which is of interest in view of the observations made above with regard to the so-called "toxic kidneys" associated with pregnancy.

Of the 31 cases in the series giving low values, 8 had no diastase at all, 2 had 2·2 units, 2 had 2·8 units, 5 had 3·3 units, and 13 had 5 units. These cases represent all the stages of the disease as met

with in the military wards of St. Bartholomew's Hospital, and the results bear no relation to the actual interval between the onset of the disease and the actual date of the examination. There is, however, a definite relationship between the severity of the case and the diastase content of the urine. Not only do the more severe cases present low values, but it is found that where these low values persist there is evidence of more permanent damage to the kidney, since these patients show liability to constant relapses. It is of interest to note that even after the albumin has disappeared low values for the diastase are obtained in these cases. The estimation appears to be of value therefore, not only in indicating the extent of kidney damage but may also be used in giving a prognosis. The question arises as to why such low values obtain in nephritis, and in no other condition. From all the available evidence it seems reasonable to assume that this ferment is excreted by way of the renal tubules, and any damage to the functional activity of these renal elements results in a depression of the permeability to this ferment.

The results under this heading indicate that there is definite damage to the secreting tubules of the kidneys in this disease, and the actual values give an indication of its extent.

TABLE SHOWING SYNOPSIS OF RESULTS OBTAINED UPON THE DIASTASE ESTIMATION OF FIFTY CASES OF ACUTE NEPHRITIS.

Date	Case No.	Age	Date of disease	Admission	Blood-pressure	Volume	Albumin per cent	Blood	Casts	Diastase
7.7.15	1	29	12.6.15	1.7.15	150	..	0·025	+	+	10
22.6.15	2	21	10.5.15	28.5.15	135	..	0·8	+	+	5
21.6.15	3	22	3 mths.	13.6.15	138	..	+	+	+	5
15.7.15	,,	,,	,,	,,	,,	..	..	..	..	28·2
25.6.15	4	26	26.5.15	29.5.15	128	..	0·1	..	+	10
22.6.15	5	29	15.6.15	21.6.15	123	..	0·5	+	+	20
23.6.15	,,	,,	,,	,,	,,	3,160	+	+	..	20
14.7.15	,,	,,	,,	,,	,,	..	0·2	..	..	20
5.7.15	6	..	7.6.15	1.7.15	125	..	Trace	..	+	20
19.6.15	7	33	28.5.15	18.6.15	188	2,322	0·15	+	+	3·3
20.6.15	,,	,,	,,	,,	,,	1,780	0·1	+	+	3·3
14.6.15	8	..	18.5.15	5.6.15	152	2,180	0·26	+	+	5
15.6.15	,,	..	,,	,,	,,	1,845	0·025	+	..	3·3
17.6.15	,,	..	,,	,,	,,	,,	0·15	+	−	10
18.6.16	,,	..	,,	,,	,,	,,	+	+	−	10
14.7.15	9	27	16.6.15	2.7.15	138	..	0 05	+	+	5
14.6.15	10	40	15.5.15	31.5.15	115	1,680	Trace	..	−	..
15.6.15	,,	..	,,	,,	,,	1,100	,,	..	−	..
18.6.15	,,	..	,,	,,	,,	1,880	,,	..	−	..
5.7.15	11	30	23.6.15	1.7.15	152	..	0·001	Trace	+	5
22.6.15	12	35	14.6.15	20.6.15	165	..	0·5	,,	+	10
7.7.15	13	49	23.6.15	2.7.15	145	..	0·1	..	+	5
11.7.15	,,	,,	,,	,,	,,	1,800	Trace	..	+	5
12.7.15	,,	,,	,,	,,	,,	,,	,,	..	..	5

TABLE SHOWING SYNOPSIS OF RESULTS OBTAINED UPON THE DIASTASE ESTIMATION OF FIFTY CASES OF ACUTE NEPHRITIS (*continued*).

Date	Case No.	Age	Date of disease	Admission	Blood-pressure	Volume	Albumin per cent	Blood	Casts	Diastase
7.7.15	14	..	..	..	..	..	0·15	..	+	22·2
9.7.15	15	30	2.6.15	2.7.15	158	..	0·025	..	+	20
9.7.15	16	19	17.6.15	1.7.15	110	..	0·35	..	+	5
7.7.15	17	42	21.6.15	2.7.15	130	..	+	..	+	5
22.6.15	18	24	21.5.15	31.5.15	135	..	0·5	+	+	10
5.7.15	19	21	14.6.15	1.7.15	138	..	Trace	+	+	20
12.7.15	20	45	14.6.15	2.7.15	145	..	..	..	..	3·3
15.7.15	,,	..	,,	,,	130	..	..	..	..	3·3
6.7.15	21	17	2.6.15	2.7.15	110	..	0·45	..	+	..
14.6.15	22	35	12.5.15	3.6.15	135	1,660	+	..	..	22·2
15.6.15	,,	,,	,,	,,	,,	1,755	Trace	..	..	22·2
17.6.15	,,	,,	,,	,,	,,	,,	,,	..	..	22·2
14.7.15	23	34	20.6.15	1.7.15	126	..	,,	+	+	3·3
9.7.15	24	23	15.6.15	2.7.15	120	..	0·001	..	+	10
6.7.15	25	28	..	..	..	..	0·3	+	+	..
14.6.15	26	28	7.5.15	26.5.15	128	1,600	0·1	+	+	3·3
15.6.15	,,	,,	,,	,,	,,	1,400	0·35	+	..	3·3
16.6.15	,,	,,	,,	,,	,,	1,723	0·15	+	..	5
17.6.15	,,	,,	,,	,,	,,	1,640	0·1	+	..	5
15.7.15	,,	,,	,,	,,	,,	..	0·025	+	..	5
19.6.15	27	37	6.6.15	18.6.15	167	2,130	Trace	..	+	10
20.6.15	,,	,,	,,	,,	,,	1,960	,,	..	..	10
21.6.15	,,	,,	,,	,,	,,	2,460	,,	..	..	10
21.6.15	28	22	11.4.15	11.5.15	128	..	0·3	+	+	2·5
9.7.15	29	39	14.6.15	2.7.15	165	..	0·001	+	+	5
19.6.15	30	30	27.5.15	31.5.15	148	1,300	0·25	+	+	5
14.7.15	31	32	16.6.15	2.7.15	135	..	0·025	..	..	10
21.6.15	32	20	21.5.15	9.6.15	165	..	0·2	+	+	2·2
15.7.15	,,	,,	,,	,,	,,	..	0·2	+	+	3·3
19.6.15	33	34	1.6.15	18.6.15	152	1,880	0·4	..	..	10
20.6.15	,,	,,	,,	,,	,,	1,380	0·4	..	..	10
21.6.15	,,	,,	,,	,,	,,	1,120	Trace	..	..	10
7.7.15	34	30	14.6.15	2.7.15	128	..	,,	+	+	10
19.6.15	35	35	9.6.15	17.6.15	168	1,280	0·55	+	+	..
12.7.15	,,	,,	,,	,,	116	..	Trace	..	+	2·2
5.7.15	36	38	7.6.15	1.7.15	148	..	0·025	+	+	20
25.6.15	37	41	23.6.15	28.6.15	155	..	Trace	..	+	20
14.6.15	38	38	2 mths.	17.4.15	115	2,115	,,	..	+	..
15.6.15	,,	,,	,,	,,	,,	1,100	,,	..	−	..
16.6.15	,,	,,	,,	,,	,,	1,780	,,	..	−	2·2
15.7.15	,,	,,	,,	,,	,,	..	,,	..	..	2·2
7.7.15	39	31	1.6.15	1.7.15	125	..	0·1	+	+	5
21.6.15	40	24	1.6.15	13.6.15	140	..	Trace	+	+	..
7.7.15	,,	,,	,,	,,	..	..	,,	..	..	5
15.7.15	,,	,,	,,	,,	112	..	..	..	..	10
5.7.15	41	27	1.6.15	1.7.15	145	..	0·25	+	+	10
15.6.15	42	22	9.5.15	9.6.15	148	1,075	.+	Trace	+.	2·5
17.6.15	,,	,,	,,	,,	,,	,,	+	,,	+	2·5
18.6.15	,,	,,	,,	,,	,,	1,505	+	,,	+	5
7.7.16	43	33	22.6.15	1.7.15	172	..	0·12	+	+	5
21.6.15	44	29	6.6.15	16.6.15	145	..	Trace	+	+	10
19.6.15	45	32	8.5.15	7.6.15	175	..	0·1	+	+	5
19.6.15	46	29	3.6.15	18.6.15	180	2,540	0·2	+	+	22·2
21.6.15	,,	,,	,,	,,	,,	1,980	0·2	..	+	22·2
19.6.15	47	41	9.6.15	12.6.15	179	..	0·2	+	+	..
15.7.15	,,	..	,,	,,	,,	..	0·2	+	..	..
19.6.15	48	20	7 weeks	17.6.15	123	..	0·3	+	+	..
19.6.15	49	33	9.6.15	16.6.15	150	..	Trace	..	+	5
5.7.15	50	34	16.6.15	1.7.15	125	..	,,	..	+	20

In view of these points attempts were made to increase the permeability of the kidneys by the administration of a diuretic such as theocin sodium acetate. Cases with a low diastase value were selected for this purpose, and although the numbers are small the results appear of sufficient value to warrant notice in this report.

The following table gives the actual results obtained, but it is hoped to carry out further investigations under this heading.

Theocin Experiments.—Influence of theocin sodium acetate on the diastase content of the urine:—

	Volume of urine in cubic centimetres	Diastase value
Case 1.		
Before		0 units
Theocin sod. acetate, gr. ii ..	3,100	20 ,,
After	1,720	3·3 ,,
Case 2.		
Before		5 units
Theocin sod. acetate, gr. ii ..	2,000	5 ,,
After	1,640	5 ,,
Case 3.		
Before	1,800	5 units
Theocin sod. acetate, gr. ii ..	2,420	5 ,,
After	1,900	5 ,,

Only in Case 1, who had been in hospital some time, did this drug have any effect in increasing the diastase content of the urine, although in every case the usual diuretic action was obtained. The increase of the diastase was, however, only temporary. Case 2, who had previously been quite free from blood, suddenly developed hæmaturia with the diuresis following the administration of theocin.

(*b*) The Nature of the Proteins Present in the Urine.

All the various protein tests have been applied to the specimens from time to time and the actual amount of protein in the urine determined. From the chemical reactions it was at once obvious that we were dealing with ordinary serum albumin and serum globulin, as usually met with in inflammatory affections of the kidneys. There has been no evidence of the presence of any other proteins such as nucleo-proteins, mucins, Bence Jones protein, altered globulins or albumoses and peptones. The optical properties of the urines were determined by the polarimeter and were found to behave just like the ordinary albuminuric urines met with in nephritis, being relatively optically inactive. This result is in

direct contrast to that found in cases of so-called functional albuminuria, or in the so-called "leaky kidneys." Additional evidence is provided by the estimation of the serum albumin and serum globulin content in certain cases. The serum albumin was always in excess of the serum globulin, and the ratio of albumin to globulin was found to range from 5 : 1 to 6 : 1. This value is again in accordance with all previous observations upon inflammatory conditions of the kidneys. From the actual amount of protein excreted, and the relative distribution of the two types of protein found, it appears that we are dealing with a true inflammatory condition which is chiefly tubular in origin.

(III) THE RETENTION OF NITROGEN IN THE BLOOD AND CEREBROSPINAL FLUID.

The estimation of the urea has been carried out according to the urease method devised by Van Slyke.[1] The principle of the method depends upon the conversion of the urea present into ammonium carbonate by the action of the ferment extracted from the soya bean. This ferment can now be prepared in a fairly pure form, and a solution of 10 per cent strength is extremely active in the presence of potassium di-hydrogen phosphate. For the estimation of urea in the blood three cubic centimetres of blood are withdrawn from a vein in the arm, mixed with solid potassium oxalate, and inserted into a small aeration cylinder. To this 3 cubic centimetres of potassium di-hydrogen phosphate (0·6 per cent) solution and 1 cubic centimetre of a 10 per cent solution of the enzyme are added. Ten to twenty minutes is quite sufficient for the urease to act upon the urea at room temperature. The mixture is then saturated with potassium carbonate, and the ammonia is drawn over into 20 cubic centimetres of $\frac{N}{50}$ acid contained in another aeration cylinder and connected by a small portion of soft rubber tubing. The aeration is allowed to run for about one hour, and the amount of acid neutralized by the ammonia determined by titration with $\frac{N}{50}$ sodium hydrate, using alizarin red as an indicator. The number of cubic centimetres of acid neutralized multiplied by the factor 0·02 gives the percentage of urea in the blood. The same procedure is followed in the cases of the cerebrospinal fluid, 2 cubic centimetres of the latter being quite sufficient in most cases. By using standardized enzyme solutions, and controlling the method with pure urea solution of known strength, the results obtained are extraordinarily accurate.

[1] Van Slyke and Cullen, *Journ. Biol. Chem.*, 1914, 19, p. 211.

As the result of a number of observations it has been found that a normal healthy individual has a urea content of the blood ranging between 0·02 and 0·04 gramme per cent.

Similarly the cerebrospinal fluid gives values for normal between 0·02 and 0·05 gramme per cent.

With regard to the analysis of the blood in cases of acute nephritis it is found that the urea content varies with the severity and duration of the disease. In cases where there is marked evidence of extensive renal changes the urea content is raised to 0·1 to 0·15 per cent, and this corresponds to a great diminution in the diastatic activity of the urine. As the symptoms subside the diastatic activity in the urine invariably returns to normal, before the urea content of the blood. Thus by combining an analysis of the blood with the estimation of the diastatic activity of the urine we are able to determine with some degree of certainty the condition of renal activity at the time of examination. This would appear to be a point of importance in the present epidemic in deciding whether doubtful convalescent cases are fit to return to military duty. The diastatic activity of the urine has been used for purposes of prognosis as will be seen from a previous paragraph in this report. A normal value appears to indicate that there is very little permanent damage to the kidneys, but at the same time such a case may still show evidence of nitrogen retention as evidenced by analysis of the blood. Under these circumstances it is advisable to carry out both determinations before coming to any definite conclusions. In passing it may be noted that the chloride retention in most cases follows almost exactly the nitrogen retention.

The cerebrospinal fluid has been investigated only in cases of uræmia, generally in patients who have died with definite symptoms, the spinal fluid obtained from other cases being used for control purposes. In all cases of uræmia the cerebrospinal fluid has shown a raised urea content as estimated by the method described above.

Table showing Synopsis of Results obtained.

Case	Blood urea	Non-protein nitrogen	C.S.F. urea	Total nitrogen	Urine, diastatic activity
Acute nephritis	0·6	..	–	..	10 units
,, ,,	0·02	..	–	..	22·2 ,,
,, ,,	0·02	0·049	0·04	0·061	10 ,,
,, ,,	0·04	..	–	..	10 ,,
Uræmia	–	..	0·066	..	..
,,	–	..	0·178	..	..
,,	–	..	0·41	..	..

The number of cases at present investigated is too small to draw any definite conclusions, but evidence is being accumulated at the present time to enable one to establish the claims made above. Much time has been expended in perfecting the method, and the material has necessarily to be drawn from civilian patients in the hospital, among whom acute nephritis is of comparatively rare occurrence.

(IV) THE POSSIBLE ORIGIN OF THE ACUTE INFLAMMATORY CHANGES IN THE KIDNEYS IN "ACUTE NEPHRITIS."

(*a*) THE QUESTION OF INTESTINAL TOXÆMIA AS A POSSIBLE SOURCE OF ORIGIN.

The possible origin of the disease from this source has been put forward, and it was therefore necessary to prove or disprove this hypothesis. The condition of indicanuria has been regarded for many years as an indication of intestinal toxæmia. I have, however, shown that such a deduction is not strictly true, and the occurrence of indicanuria is of no diagnostic significance in itself. The association, however, of marked indicanuria with urobilinuria and oxaluria appears to be of much greater value, as indicating some abnormal intestinal changes. Now in all the cases of acute nephritis examined, no association of these three urinary conditions has been met with. There have only been the slightest traces of indican, and no urobilin, or calcium oxalate crystals. These observations, therefore, give no support to the intestinal toxæmia theory. A far more reliable method of detecting signs of intestinal putrefaction is provided by a determination of the total quantity of ethereal sulphates present in the urine, since these are found to be much increased in such conditions. A number of estimations of the total sulphates, inorganic sulphates, and ethereal sulphates have been made and the actual figures are recorded in the subjoined table. A comparison of these figures with those for normal healthy individuals given at the bottom of the table will demonstrate that there is no excess of ethereal sulphates in any of the cases examined. The figures correspond roughly with the minimum values for normal persons, and in view of the fact that all these patients were on a low protein diet, this is sufficiently explained. The results, therefore, tend to show that there is no evidence of any intestinal toxæmia considered in the broad sense. The origin of the acute nephritis from such a source is consequently excluded.

ESTIMATION OF SULPHATES IN URINE.

Case	Age	Date of disease	Date of admission	Date of estimation	Volume	Total sulph. per cent	Inorg. sulph. per cent	Ether sulph. per cent	Total sulph. total	Inorg. sulph. total	Ether sulph. total
A	38	2 months	17.4.15	14.6.15	2,115	0·1696	0·1616	0·008	3·487	3·417	0·070
				15.6.15	1,110	0·1216	0·120	0·0016	1·337	1·32	0·017
B	28	7.5.15	26.5.15	14.6.15	1,600	0·1776	0·1696	0·008	2·841	2·713	0·0128
				15.6.15	1,400	0·136	0·129	0·007	1·904	1·806	0·098
C	40	15.5.15	31.5.15	14.6.15	1,680	0·134	0·121	0·015	2·251	2·032	0·219
				17.6.15	..	0·158	0·153	0·005	..	..	..
D	35	18.5.15	5.6.15	14.6.15	2,180	0·116	0·113	0·003	2·528	2·463	0·065
				15.6.15	1,845	0·112	0·108	0·003	2·066	2·007	0·059
E	22	9.5.15	9.6.15	15.6.15	1,075	0·065	0·064	0·001	0·698	0·688	0·010
F	34	1.6.15	18.6.15	19.6.15	1,880	0·117	0·112	0·005	2·199	2·105	0·094
				20.6.15	1,380	0·1408	0·136	0·0048	1·943	1·876	0·067
G	37	6.6.15	18.6.15	19.6.15	2,130	0·056	0·052	0·003	1·192	1·107	0·085
H	33	28.5.15	18.6.15	19.6.15	2,322	0·092	0·084	0·007	2·136	1·950	0·018
I	29	3.6.15	18.6.15	19.6.15	2,540	0·0912	0·086	0·005	2·316	2·194	0·022
	Normal Persons—										
	Average	..	..	..	1,330	0·162	0·138	0·013	2·16	1·83	0·18
	Maximum		..	..	1,835	0·167	0·135	0·032	3·08	2·48	0·27
	Minimum		..	..	920	0·168	0·152	0·016	1·55	1·40	0·10

(*b*) THE EXCRETION OF MINERAL POISONS BY THE KIDNEY AS A POSSIBLE FACTOR.

The amount of diastase in the urine in experimental poisoning with the heavy metals has been determined, and found to be invariably subnormal. Since these metals interfere mainly with the tubular functions of the kidney, it is reasonable to suppose that the diastase in the urine is excreted by this route. There has, however, been no evidence of any heavy metals in the urine in these cases, and the general characters of the disease appear to be unlike those met with in poisoning by such agencies. In only one case in civil practice have I met with a true nephritis due to mercurial poisoning, and the urinary analyses were quite different from those recorded above. The diastase content was markedly subnormal, there was a relative excess of serum globulin, the ratio of albumin to globulin being 3 : 1, and the proteins were optically active. We should expect that if the cases in question were due to metallic poisoning there would be a preponderance of casts showing fatty degeneration. These fatty casts, on the other hand, are of extreme rarity amongst the cases examined. The question of arsenical poisoning has also received attention, no traces of arsenic being detected in the hair of a number of cases examined.

It was thought possible that if this acute nephritis was pro-

duced by mineral poisons small quantities of the mineral could be detected in the urine of such cases. For this purpose the method of ultra-filtration was adopted, collodion sacs being used for the purpose. The sacs were made according to the directions given by Walpole,[1] a whole series being set up, and surrounded by a continuous stream of water. Several specimens of urine from early cases of this disease were submitted to ultra-filtration dialysis, phenol being used as a preservative. Quantities of urine varying from 2 to 4 litres were driven through the collodion sacs under a pressure equal to 20 mm. Hg. In this way the urine was rapidly concentrated down to about 30 cubic centimetres, most of the crystalline constituents being removed, and only the colloidal substances and heavy metals remaining in the sac. This colloidal concentrated material is described as the "concentrate" in this paper. Control experiments were made with urine from normal healthy individuals, and also with the same urine and distilled water, to which small quantities of salts of the heavy metals were added. Analysis of the concentrate from the cases of acute nephritis showed that salts of the heavy metals were entirely absent. The added mineral salts were found to be retained in the collodion sacs in the control experiments, and it was thus possible to detect very small quantities of these salts in solution. The method was found to be capable of demonstrating one part of arsenic (As_2O_3) in one million parts of water, and some of the heavier metals such as mercury, lead and antimony in even smaller dilutions. These experiments, therefore, tend to demonstrate that the urines of cases of acute nephritis did not contain salts of the heavy metals in sufficient quantity to be detected by this method and not therefore in quantity sufficient to produce such marked renal changes. The results of the analysis of the concentrates are of interest in this connexion as demonstrating the nature of the substances which are held back by ultra-filtration through collodion membranes, more especially as these concentrates have been used for some of the animal experiments detailed below.

		Concentrate			
		Volume	Blood	Albumin	Total solids
Case 1	4 litres of urine used	25 c.c.	±	±	0·9 per cent.
,, 2	6 litres of urine used	40 c.c.	±	±	0·85 ,,
,, 3	Normal urine, 4 litres	40 c.c.	0	0	0·2 ,,
Cases 4 and 5	2 litres of urine used	35 c.c.	±	±	0·8 ,,

[1] Walpole's *Biochem. Journ.*, 1915, ix, p. 284.

The concentrate contained all the albumin present in the urine, a small quantity of the blood, the ferments, micro-organisms and toxins. The total solids were identical in amount in every case of acute nephritis, but much diminished in the specimen of normal urine, this difference being accounted for by the albumin present. The concentrates containing albumin became almost solid on boiling with a trace of acetic acid. The ash content of such concentrates was so small that accurate weighing was difficult, and also prevented a complete chemical analysis of the ash. This shows that practically all the salts had been filtered off, or dialysed away in the filtrate. The nature of the substances which passed through the collodion membrane was determined by a modified method, a filter press containing sheets of collodion being used. Urine containing blood and albumin was driven through the filter press under great pressure, and the filtrate collected for analysis. Practically all the urea, uric acid, creatinins, amino-acids, chlorides, phosphates, and sulphates were recovered in this filtrate, together with most of the blood. It is of interest to note that the filtrate, whilst at first acid in reaction, soon became alkaline and the resulting concentrate was always alkaline. The concentrate was quite sterile in every case, and contained just sufficient phenol to enable it to be kept for months in the laboratory. The concentrate could be passed through a Berkefeld filter, the filtrate possessing the appearance of a clear homogeneous fluid with a slight reddish tinge in cases where urine containing blood was used. The greater part of the hæmoglobin, however, passed through the collodion sac, together with most of the normal urinary pigments. The use of these collodion sacs, therefore, appears of great value not only in isolating and detecting abnormal constituents in the urine, but to have an application to water analysis, and also for the preparation of colloids and pigments in a fairly pure state. It may here be noted that the method has been used by Walpole for the concentration of diphtheria toxin in serum. The writer is much indebted to Dr. G. S. Walpole for the supply of the collodion which rendered this work possible.

(c) The Question of an Infective Origin of the Renal Changes.

(1) *By Direct Bacterial Infection of the Kidney.*

The existence of an acute infection has been suggested to account for this outbreak of nephritis. It is possible that the renal changes observed may be due either to the direct action of

infecting organisms on the renal epithelium, or to the chemical products of their activity liberated into the blood from some septic focus, and exerting a specific toxic action on the kidneys. The first of these possibilities has been subjected to a thorough investigation, and it may be said at once that there is no evidence to support such a contention. This is brought out quite conclusively in the report by Langdon Brown in the July number of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS. All the catheter specimens of urine of the cases investigated at St. Bartholomew's Hospital yielded negative results as regards any infection of the urinary tract; and this I believe has been the experience of others who have followed this particular line of investigation. Similarly negative results have been obtained with blood cultures from these cases. Lieutenant-Colonel M. H. Gordon very kindly made both aerobic and anaerobic cultures of the blood and urine of a few acute cases, and has kindly allowed me to refer to them here. In every case no definite organism could be detected which was responsible for the renal lesions. Various samples of blood were tested by Lieutenant-Colonel Gordon for the agglutination tests against three types of meningococci with negative results in every case. The possibility of the disease having its origin in a meningococcal infection was thus ruled out, in addition to the absence of the meningococcus in the throat cultures made from these cases. Although no direct microbic infection of the urine and blood could be demonstrated, there is still a second possibility to be considered, namely, the existence of some localized septic focus. Suffice it to say that all attempts that have been made to locate such a focus have completely failed up to date. The details of the bacteriological flora of the throat in these cases is given in Langdon Brown's report referred to above, the results proving inconclusive. There is, however, still the possibility that a septic focus may exist in some other situation, e.g., the teeth, since some of the patients appeared to have bad teeth. It is certainly difficult to assign the cause of acute nephritis to oral sepsis, since one would expect that the disease would have occurred in much larger numbers. Further, oral sepsis would appear to be a mere coincidence, and not a marked feature of even the greater bulk of the cases. Again, it is true that a number of the cases suffered from chronic bronchitis, but this was not surprising in view of the nature of the civil occupation of many of those affected. Granting that these conditions may act as a predisposing cause, there is no evidence to show that an epidemic of a disease, rare in civil practice, affecting comparatively healthy

men, can be explained in this way. The following observations represent an attempt to determine if possible whether the disease originates as the result of a microbial infection. Although there are many features appertaining to this disease as met with in France which lead one to assume that it is of an infective nature, yet it is a matter of extreme difficulty to bring forward conclusive proof. The great difficulty which every one has experienced is to reproduce this disease in animals, except by the use of drastic reagents such as strong bacterial emulsions, mineral poisons, or powerful drugs. Too much reliance cannot be placed upon animal experiments alone for the reproduction of the same disease, more especially as we know that animals differ very much as regards their susceptibility. We know, for example, that poliomyelitis cannot be transmitted to rabbits, a point of special significance in the present investigation, as will appear later in this paper.

(2) *The Excretion of Toxic Substances as in the Urine of Acute Nephritis.*

Bouchard[1] has proved by numerous experiments that the twenty-four hourly specimens of urine, whether normal or abnormal when filtered and neutralized, has a definite toxicity for animals according to the weight of the given animal. He ascertained that it requires on the average fifty grammes of normal urine to kill a rabbit of one kilogramme by intravenous injection. This work has been confirmed by several subsequent observers, and attempts have been made to prove the nature of the toxic agent in the urine. Since it is known that the urine in nephritis is more toxic than normal urine, it was necessary to consider the whole question of urinary toxicity in carrying out experiments on animals. The opinion has gained ground that the potassium salts are responsible for the toxic action of normal urine, but in nephritis the excretion of potassium salts is diminished. The presence of potassium salts, therefore, does not appear to be a sufficient explanation of the effects observed. Since albumin is one of the most prominent abnormal constituents of the urine in nephritis, we might assume that the increased toxicity is thus explained. A number of experiments performed by the writer reveal the following facts with regard to the nature and action of albumin in the urine. For the sake of brevity the general results will be given, as the whole work represents three

[1] Bouchard, "Leçons sur les auto-toxications," Paris, 1837.

years' labour in differentiating the various forms of albuminuria and their significance.

(1) The injection into an animal of urine containing protein largely in the form of serum albumin leads to its rapid reappearance in the urine of the animal in an unchanged form. A transitory albuminuria results, lasting about two days. I believe that hæmoglobin similarly injected undergoes a similar change.

(2) Removal of the protein from the urine before injection does not alter the toxicity, and no temporary albuminuria results. The most suitable reagent for removing the albumin from urine is colloidal aluminium hydroxide specially prepared free from soluble aluminium salts.

(3) The albumin in the urine in nephritis is an absolute inert substance producing no anaphylactic reaction or specific precipitin. Further, it is to all intents and purposes optically inactive. This explains why it is rapidly excreted by the kidneys after injection. In all respects it differs from the serum albumin in the blood. On these grounds it is assumed that the kidneys play an active part in nephritis in stripping the albumin of its chief properties, and do not act as mere passive filtering agents. The kidneys are known to do an enormous amount of work as determined by energy exchanges in these organs, and in all probability many important syntheses take place here. There seems reason to believe that the kidneys produce some alteration in the bile salts excreted in the urine in certain forms of jaundice. Certain it is that the bile salts in the urine have completely lost their property of producing hæmolysis of red blood cells.

(4) Urine concentrated by ultra-filtration according to the method described in this paper undergoes very definite changes. The salts, urea, uric acid, creatinine, and other crystalloids pass through the collodion sacs, leaving all the colloids and heavy metals behind, the latter constituting the chief bulk of the solids of the concentrate. Reference to the animal experiments appended will show that this concentrate is capable of producing certain definite effects, and that this property is lost if the concentrate is allowed to stand, or if it is heated to 55° C. previous to injection. Further, removal of the albumin from the concentrate resulted in a complete disappearance of these effects upon animals. This would at first sight suggest that the albumin was the important constituent, but this alone will not explain the experiments with fresh sterile urine or the result of heating the concentrate to 55° C., and the inactivation on simply standing at room temperature. The appended

observations tend to show that the observed toxicity of the urine in cases of nephritis is not due to the albumin present either qualitatively or quantitatively. The potassium salts also will not explain the action of these urines, since they are present in such small quantities, and completely absent from the ash of the concentrate. Further, the potassium salts should exert their action, no matter what the subsequent treatment of the concentrate. The effects of intravenous injection of urine obtained by catheter from acute cases were determined upon rabbits, and intraperitoneally on monkeys. For these specimens the writer is indebted to the Officer Commanding No. 11 General Hospital, Boulogne, and obtained during a visit to Boulogne in September, 1915, rendered possible by the kindness of the Medical Research Committee. The following three cases were investigated :—

Case 1.—McC., private, aged 22. Onset of nephritis, August 26, 1915; specimens of blood and urine obtained September 17, 1915.

Case 2.—E. J. M., private, aged 31. Onset of nephritis, September 1, 1915; specimens of blood and urine obtained September 17, 1915.

Case 3.—B., private, aged 33. Onset of nephritis, September 4, 1915; specimens of blood and urine obtained September 17, 1915.

All the urines contained blood and albumin, casts, and white blood cells. The catheter specimens were sterile in each case, and were used exclusively for animal experiments. The twenty-four-hourly specimens were obtained, and when collected together were concentrated by ultra-filtration, and the concentrate used for animal experiments.

The catheter specimens when injected gave rise to well-marked toxic effects in both rabbits and monkeys following injection, necessitating the use of small quantities of urine even for larger rabbits. The experiments numbered 7, 8, 9, 11, 12 and 13, and in the subjoined list, illustrate this action. It will be seen that the quantities used were considerably below the standard given by Bouchard and others to produce toxic effects in rabbits. The results therefore point to the presence of some powerful toxic agent in the urine of cases of acute nephritis, and attempts were made to ascertain its nature. In the course of this work it was noted that the urines possessed a very distinct odour somewhat resembling that of the higher alcohols. This odour was invariably present in the early cases, whether they contained blood or not. Another point was the deep pigmentation quite apart from any blood contamination. The odour was thought to be due to some volatile

substance, but aeration, distillation *in vacuo*, and steam distillation did not yield any results. The occurrence of a sulphide or sulphuretted hydrogen was also excluded. The nature of the pigment was also investigated, especially as it was found to interfere very markedly with the sulphur determinations in the urine subjected to hydrolysis with acids. In many cases it was necessary to remove this pigment before making the analysis. The pigment was found to yield substances closely resembling indol in its chemical characters; this indol was not excreted in the form of ethereal sulphates as shown by the low values obtained in the table given in an earlier part of this paper and only the faintest traces of indican could be detected in the urine. I have come to the conclusion that the synthesis of ethereal sulphates possibly takes place in the kidney, and any damage to the kidney produces a diminution in this power. The result is that indol and other similar compounds pass through the kidney in some other form, and may possibly explain the toxicity observed in such urines. It is of interest to note that such urines when treated with charcoal and filtered lost their toxicity, and also these indol derivatives. The accumulation of such substances in the blood may possibly explain the onset of uræmia, and this point is at present receiving attention. The absence of the salts of the heavy metals or of any pharmacological products is against the effects being produced by such means, so that again mineral poisoning as a possible origin of the disease is excluded.

The experiments with the catheter specimens of urine therefore show that we are dealing with some definite toxic agent common to all forms of nephritis. This urine when given in sufficient quantity rapidly produces death in rabbits, but only mild toxic effects which rapidly pass off when a smaller dose is given. In no instance has such administration produced the disease in animals, even after repeated injections have been given. It appears, therefore, that the toxic substance or substances in question are not responsible for the production of acute nephritis, but rather that they are the collateral result of the pathological changes involved.

(3) *The Possible Presence of "Filter Passers" in the Urine of Cases of Acute Nephritis.*

Several animal experiments have been carried out with the object of ascertaining whether the lesions in the kidney were to be explained by infection with an ultra-microscopic organism, that

is a "filter-passer." At the outset it may be stated that although there is strong presumptive evidence that such an infection does exist, it has so far been impossible to reproduce the disease either in monkeys or rabbits. The experiments have not been sufficiently numerous owing to lack of suitable material at the time, but it is hoped to pursue this phase of the investigation at a later date. The most striking feature of all the experiments was the sudden illness which supervened on or about the eighth day after the injection. This feature was so striking as to excite attention amongst all the animals under observation. Two of the animals died with definite albuminuria, yet histological evidence was quite negative as regards any inflammatory changes in the kidneys. Death in both these rabbits supervened on the tenth day following the injection, and it is just possible that the illness was too acute for any marked histological changes to occur. The evidence as regards the experiments upon monkeys with catheter specimens of urine is similar to that obtained with rabbits. The two animals showed very definite signs of illness following the injection, and also eight days afterwards. They were both injected intraperitoneally with ten cubic centimetres of urine from two acute cases, but there was no local reaction. The sudden onset of symptoms on or about the eighth day in both monkeys and rabbits is of significance and cannot be explained on any theory of toxic action of the urines used. Further, the same effects were observed whether fresh sterile urine was used or urine in the form of concentrate, provided the latter was fresh. Previous treatment of the urine by heating to 55° C. abolished all these symptoms, but filtration through a Berkefeld filter had no such effect. We appear therefore to be dealing with some agent which is destroyed at a temperature of 55° C. but which is capable of passing through a Berkefeld filter, and not through a collodion sac, and gives rise to illness in animals eight days after injection. These points all trend towards an ultra-microscopic organism as the possible cause of acute nephritis, and present in the urine in the early stages of this disease. So far, however, it has not been possible to reproduce the same disease in either monkeys or rabbits. This in view of what has been said already may not be surprising. Finally, reference should be made to a comparison between this form of acute nephritis and that met with in scarlatina, where many points of resemblance are seen. The significance of these results is still further enhanced when we consider that the prevailing opinion at the moment is that scarlatina is due to an ultra-microscopic organism.

Record of Animal Experiments.

Experiment 1.—Private C.: Onset of nephritis, June 1, 1915. Admitted to St. Bartholomew's Hospital, July 1. July 24: Urine 2,000 cubic centimetres, containing much blood, albumin, and casts; urine concentrated to 25 cubic centimetres by ultra-filtration at a pressure of 20 mm. Hg., phenol being used as a preservative. July 28: 2 cubic centimetres of concentrate previously filtered through Berkefeld filter injected intravenously into a rabbit. August 3, *i.e.*, six days later, the animal developed albuminuria. August 5: Animal after three days illness died, the urine still containing albumin, but no blood.

Post-mortem: The kidneys appeared enlarged, and much engorged with blood. Microscopically no marked histological changes could be detected, apart from engorgement of the vessels. All the other organs appeared natural.

Experiment 2.—The same experiment was performed on another rabbit and the results were identical in every respect. Death occurred on the tenth day after injection, with albuminuria. No evidence of acute nephritis found in the kidneys post mortem.

Experiment 3.—The concentrate as used in the above two experiments was first passed through a Berkefeld filter, and the filtrate heated to 55° C. for half an hour. Two cubic centimetres of this heated filtrate were injected intravenously into a rabbit. The rabbit showed no ill-effects following this injection and remained perfectly well.

Experiment 4.—Opalescent serum from a patient dying of acute nephritis was obtained, and the opalescence removed by passage of the serum through a Berkefeld filter. Two cubic centimetres of this filtrate were injected into a rabbit. No ill-effects followed upon the injection. On the eighth day the rabbit was ill, but there was no albuminuria. Twenty-four hours afterwards the animal was again normal, and remained so.

Experiment 5.—Cerebrospinal fluid from a case of acute nephritis with uræmia used. Five cubic centimetres of the clear fluid were injected intravenously into a rabbit. No ill-effects were observed, and the animal remained healthy.

Experiment 6.—Serum from Case 3 recorded in the text was used for this experiment, an early case of acute nephritis. Two cubic centimetres of the clear serum were injected intravenously, followed by severe symptoms on the eighth day. The animal, however, rapidly recovered.

Experiment 7.—Catheter specimen of urine, Case 1, found to be

quite sterile. Twenty cubic centimetres of the filtered urine injected intravenously into a rabbit. The animal was seized with convulsions and died almost immediately. Post-mortem examination showed no emboli or any abnormality to account for this sudden death.

Experiment 8.—The same urine as in Experiment 7 was used, but in this case ten cubic centimetres only were given. The animal, although showing the typical toxic effects, subsequently recovered, and remained apparently normal until the eighth day. On this day it was found lying at the bottom of the cage and was thought to be dying. There was no blood or albumin in the urine. The next day it had quite recovered and remained quite well up to three weeks after the injection. The rabbit was then suddenly seized with convulsions, and paralysis of the right side of the body. There was no œdema or albuminuria. Incontinence of urine and fæces developed, and subsequently albuminuria but no hæmaturia. Ten days after the onset of this paralysis the animal died, and post-mortem examination revealed the presence of a cerebral hæmorrhage extending into the medulla.

Experiment 9.—Catheter specimen of urine from Case 2, previously found to be sterile. Ten cubic centimetres of the filtered urine were given intravenously into a rabbit, the animal dying in less than ten minutes afterwards. Unfortunately a post-mortem examination could not be made as the animal had inadvertently been cremated.

Experiment 10.—The same urine as used in Experiment 9, this time only five cubic centimetres being used for injection. The animal recovered from the toxic effects, but was taken ill on the eighth day. It showed exactly the same changes as the other animals reported above and subsequently recovered. No albuminuria was detected.

Experiment 11.—A catheter specimen from an acute case, No. 3; five cubic centimetres of this sterile urine were sufficient to kill the rabbit in a few minutes. No abnormality was found post mortem.

Experiment 12.—The catheter specimen from Case 2 used in Experiment 9 used for experiment upon a monkey. Ten cubic centimetres of this sterile urine were injected intraperitoneally into a monkey under an anæsthetic. The next day the animal was found lying at the bottom of its cage with marked head retraction, and apparently very ill. Within twenty-four hours it had quite recovered, to be again seized with the same symptoms on the eighth to ninth day after the intraperitoneal injection. It was thought

to be dying with the signs and symptoms of meningitis, but slowly recovered without developing any signs pointing to acute nephritis. During this illness it appeared to have a raised temperature and a rapid weak pulse.

Experiment 13.—Ten cubic centimetres of urine obtained by catheter from Case 3, filtered, and injected intraperitoneally into a monkey under an anæsthetic. The toxic effects were not so marked, possibly due to the fact that the monkey was a larger animal than that used in Experiment 12. The same illness supervened on the seventh day, but was not so severe as in the previous experiment. The monkey recovered completely, and did not show any signs of nephritis at any stage of the experiment.

Experiment 14.—The twenty-four-hourly specimens of urine from Cases 2 and 3 were subjected to ultra-filtration. The concentrate measured thirty-five cubic centimetres. This concentrate was passed through a Berkefeld filter, and the filtrate collected was used for this and the two succeeding experiments. The filtrate was quite clear but possessed a slight brownish tinge due to the presence of blood. A monkey received five cubic centimetres of this concentrate intraperitoneally. The next day it was taken acutely ill with head retraction and prostration. It was quite conscious, but showed no movements on being touched. Food and drink was left untouched. On the following day it partially recovered, and remained in this condition until the eighth day, when it appeared to be dying. It, however, recovered, to subsequently succumb from broncho-pneumonia six weeks later. The kidneys appeared normal both macroscopically and microscopically.

Experiment 15.—Two cubic centimetres of the concentrate as used in the previous experiment were injected intravenously into a rabbit. This animal died on the eighth day in convulsions. There was no albuminuria or hæmaturia, and no cause of death could be found.

Experiment 16.—In this experiment the filtered concentrate was heated to 55° C. for half an hour previous to injection. Two cubic centimetres of the heated concentrate were injected intravenously into a rabbit. No ill-effects followed the injection, and the animal remained quite well.

Experiment 17.—A repetition of Experiment 15, with the exception that the unheated concentrate had stood for several days in a sterile flask at room temperature. No ill-effects either immediate or remote followed this injection.

Experiment 18.—The albumin was removed from a portion

of the concentrate, and the filtrate injected into a rabbit, two cubic centimetres being given intravenously. No ill-effects followed the injection.

(*d*) The Characters of the Urine in Cases of Scarlatinal Nephritis.

Since some observers, notably our French colleagues, have claimed that the epidemic of acute nephritis in France is scarlatinal in origin it was deemed advisable to investigate this type of nephritis along the same lines. They suggest that it occurs in slight undetected cases of scarlatina, but no actual proofs are forthcoming from actual observations of early cases of acute nephritis both in France and in this country. The data obtained amongst civilian fever hospitals in Great Britain point to the occurrence of this complication of scarlatina in about ten per cent of the cases. In view of the large number of cases of nephritis met with amongst members of the Expeditionary Force, such an origin would mean a vast epidemic of scarlatina if based on such a figure, and we know that an outbreak of such magnitude did not occur. This alone is strong evidence against the scarlatinal origin of the disease. There are, however, some points which are worth considering, the evidence adduced being mainly of a negative character. In the first place, the onset of the nephritis appears to be so sudden that any previous illness may be quite obscured, or not regarded as of any significance. With men who have been in the trenches, exposed to variable climatic conditions, and wearing the same clothes day and night, it is not surprising that data are lacking as regards headaches, sore throat, vomiting, and the presence of a rash. In many of the cases of scarlatinal nephritis which have come under my notice, these symptoms have also apparently escaped notice, and only when the nephritis has developed has suspicion been aroused and definite evidence of desquamation obtained. Frequently one obtains a history of a so-called influenzal attack preceding the signs and symptoms of the "trench nephritis," a not uncommon history in civilian cases of scarlatinal nephritis. We have also the evidence of particular groups of men being attacked, and also the complete absence of this disease amongst the Indian troops, subjects known from past experience to be quite immune to scarlatina. That the disease in question is of infective origin there seems to be little doubt, not only from the curve of the epidemic, the distribution of the cases, and the seasonal prevalence. A comparison may here be made

between this epidemic in France and the similar epidemic which prevailed during the American Civil War, details of which may be found in the admirable records of the Surgeon General's Department. The curves prepared by Captain Langdon Brown from these figures demonstrate this feature, and will be published later. The cases of scarlatinal nephritis were kindly supplied by Dr. Thomson, Medical Superintendent, North-eastern Fever Hospital, London, to whom the writer would express his gratitude. These cases of scarlatinal nephritis have been investigated along the same lines as detailed above for the cases of acute nephritis, i.e., microscopical characters and nature of flora, if any, of catheter specimens. The diastatic activity of the urine has also been determined on several occasions, together with chemical analysis of twenty-four-hourly specimens whenever available. The results are given in the following table, and appear to show the following characters. In the early stages of scarlatinal nephritis the urine generally contains albumin in quantity, and frequently also blood in the form of fresh red blood cells. Microscopically, the chief features noted are the relative excess of hyaline casts and white blood cells. The latter character is of almost constant occurrence, and appears to persist for some days after all casts have vanished. Again, the diastatic activity serves to demonstrate the degree of tubular damage, since patients showing a very low diastase content were invariably acutely ill, and in two cases died very soon after the onset of this complication. With the improvement in the patient's condition the diastase content rose to normal values, and remained at this level. The chemical analysis of the urine was somewhat difficult, as twenty-four-hourly specimens were examined, but certain points were ascertained. In the first place it may be stated that all the patients were placed upon a milk diet of about the same daily average amount. The results show that there was a retention of nitrogen and also of chlorides, and that this retention persisted after the diastatic activity had regained the normal value. This same character has already been noted in the cases of acute nephritis which have come under observation. The evidence obtained therefore points to the fact that in scarlatinal nephritis we are dealing with an acute tubular nephritis, with some glomerular changes as well. It has been possible to secure histological evidence in one of the patients under examination, who died from uræmia following acute nephritis. A brief account of this case may be of interest here.

J. S., aged 5, admitted to the North-eastern Fever Hospital on

Table showing Results obtained with Cathetfr Specimens of Urine from Cases of Scarlatinal Nephritis.

Date	Name and age	Date of Disease	Day of onset of nephritis	Day of nephritis	Appearance of urine	Reaction	Albumin	Blood	Micro-scopically: Granular casts	Hyaline casts	Epithelial casts	White blood cells	Red blood cells	Crystals	Organisms	Cultures: 1 c.c.	$\frac{1}{10}$ c.c.	$\frac{1}{100}$ c.c.	$\frac{1}{1000}$ c.c.	$\frac{1}{10000}$ c.c.	$\frac{1}{100000}$ c.c.
8.11.15	Armsly, 6 yrs.	26th day	20th day	6th day	Thick, turbid	Acid	Trace	..	..	..	..	++	..	Amorphous urates	..	..	..	..	..	..	..
,,	Strykowski ..	33rd ,,	28th ,,	5th ,,	Clear, pale colour	,,	..	..	..	..	..	++	..	..	A few motile bacilli	*B. coli*	*B. coli*	..	..	..	..
11.11.15	Dudley ..	23rd ,,	20th ,,	3rd ,,	Turbid, pale colour	,,	+	..	..	+	A few	+++	..	..	..	..	..	..	..	..	..
,,	Lines, 4 8/12 yrs.	52nd ,,	22nd ,,	30th ,,	Clear, pale yellow	,,	+	..	+	+	..	++	..	..	..	*B. coli*	..	..	..	..	..
12.11.15	Hurley, 5 yrs.	31st ,,	19th ,,	12th ,,	,, ,,	,,	Trace	..	..	..	..	++	..	..	..	..	..	..	..	..	..
,,	Price, 6 yrs.	38th ,,	16th ,,	15th ,,	Blood stained	,,	+	+	+	+	+	++	+	..	..	*B. coli*	..	..	..	..	..
,,	Stein, 5 yrs.	23rd ,,	21st ,,	2nd ,,	Smoky, turbid	,,	0·025 %	+	..	++	..	++	+	..	..	..	..	..	..	..	..
,,	Cundy, 8 yrs.	29th ,,	21st ,,	8th ,, (Blood, 2nd day)	Smoky	,,	0·1%	+	..	+	..	++	+	..	..	..	..	..	..	..	..
23.11.15	Garrett, 3 yrs.	21st ,,	20th ,,	1st ,,	Clear, pale yellow	,,	0·05 %	..	..	..	..	++	..	..	..	..	..	..	..	–	–
,,	Wylie, 4 yrs.	20th ,,	18th ,,	2nd ,,	Blood stained	,,	+	+	..	+	..	++	+	Calcium oxalate	..	*Streptococcus fæcalis*, *M. tetragenus*					
8.12.15	,, ,,	35th ,,	..	17th ,,	,,	,,	Trace	+	..	+	..	++	+	..	..	..	..	..	..	–	–
23.11.15	Nice, 6 yrs.	20th ,,	18th day	2nd ,,	Clear, pale yellow	,,	,,	..	..	+	..	+	+	Calcium oxalate	..	*S. fæcalis*, *B. coli*	..	..	..	–	–
3.12.15	Sullivan ..	9th ,,	9th ,,	1st ,,	Blood stained	,,	0·15 %	+	..	..	..	+	+	Calcium oxalate	..	..	..	..	..	–	–
,,	Skipper, 5 yrs.	25th ,,	(?) 19th–22nd day	3rd ,,	,,	,,	0·25 %	+	..	++	..	++	+	..	..	..	..	..	..	–	–
,,	Radley ..	23rd ,,	22nd ,,	1st ,,	Clear, pale yellow	,,	Trace	..	..	+	..	+	..	Calcium oxalate	..	*B. coli*	..	..	..	..	..
8.12.15	O'Connell, 3 years	23rd ,,	22nd ,,	1st ,,	,, ,,	,,	,,	..	..	+	..	++	+ a few	..	..	..	..	..	..	..	..

14.12.15	Geddes ..	34th day	32nd day	2nd day	Blood stained	Acid	0·05 %	+	..	+	+	+	+	Calcium oxalate	..	..	..	..	..	..	..
17.12.15	,, ..	37th ,,	32nd ,,	5th ,,	,, ,,	,,	0·2 %	+	..	+	+	+	+	+	..	..	..	..	..	..	..
20.12.15	Stone, 15 yrs.	2—3 weeks	(?) 19th —22nd day	1st ,,	Deeply blood stained	,,	0·4 %	+	..	+	+	+ +	+	..	..	..	..	..	..	..	..
,,	Farmer ..	58th day	56th ,,	2nd ,,	Smoky urine	,,	Trace	+	..	..	..	+	+	..	..	..	..	..	..	..	..

Non-catheter Specimens of Urine.

2.11.15	Lines, 4 $\frac{8}{12}$ yrs.	39th day	21st day	2nd day	Blood stained	Acid	0·1 %	+	+	+	..	+	+	..	+	*B. coli* and streptococci	*B. coli*	*B. coli*	*B. coli*	*B. coli*	*B. coli.*
,,	Whiting, 4 yrs.	33rd ,,	24th ,,	9th ,,	Clear, pale yellow	,,	Trace	..	..	+	..	+	..	Uric acid	+	*B. coli* and streptococci	*B. coli* + streptococci	,,	,,	,,	,,
,,	Hurley, 5 yrs.	21st ,,	19th ,,	2nd ,,	,, ,,	,,	0·05 %	..	..	+	+	+ +	..	Calcium oxalate	+	*B. coli* (?) Streptococci	*B. coli* + streptococci	*B. coli*	..	..	..
6.11.15	Good, 6 yrs.	28th ,,	19th ,,	9th ,,	Smoky urine	,,	Trace	+	+	+	..	+ +	+	..	+	*B. coli*	*B. coli*	*B. coli*	*B. coli*	*B. coli*	*B. coli.*
,,	Redbane ..	26th ,,	22nd ,,	4th ,,	Blood stained	,,	0·1 %	+	..	+	..	+ +	+ +	..	..	Streptococci, *B. coli*, and large Gram-positive bacillus	,,	,,	,,	,,	,,

Table showing Results of Analysis of Urine from Cases of Scarlatinal Nephritis.

Date	Name and age	Day of nephritis	Volume	Albumin	Blood	Casts	Crystals	Diastase	White blood cells	Chlorides		Total nitrogen		Area	
										Per cent	Total	Per cent	Total	Per cent	Total
2.11.15	Webb ..	Convalescent	–	..	..	..	Uric acid ..	20 units	+	..	..	..	..	..	..
,,	Vincent, 5 yrs.	15th day ..	300 c.c.	0·025 %	+	+	..	5 ,,	+	0·181	0·543	..	..	..	..
,,	Curtis ..	21st ,, ..	1,100 c.c.	Trace	Trace	+	..	5 ,,	+	0·093	1·023	..	..	..	..
5.11.15	,, ..	24th ,, ..	1,300 c.c.	,,	..	+	..	5 ,,	+	0·111	1·443	0·28	3·41	0·146	..
18.11.15	,, ..	37th ,, ..	1,220 c.c.	Cloud	..	+	..	5 ,,	+	0·093	1·134	..	..	..	..
2.11.15	Good, 6 yrs. ..	5th ,, ..	550 c.c.	0·001 %	+	+	..	10 ,,	+	0·087	0·478	..	..	..	..
6.11.15	,, ,, ..	9th ,, ..	620 c.c.	Trace	+	..	..	10 ,,	+	0·187	1·159	..	..	..	..
2.11.15	Lines, 4 8/12 yrs.	2nd ,, ..	400 c.c.	0·1 %	+	+	..	10 ,,	+	0·397	1·588	..	..	..	..
11.11.15	,, ,,	9th ,, ..	–	+	..	+	..	10 ,,	+	..	..	..	..	..	..
12.11.15	Whiting, 4 yrs.	..	1,280 c.c.	..	..	+	Uric acid ..	5 ,,	+	0·152	1·945	..	..	..	..
18.11.15	,, ,,	..	1,470 c.c.	..	..	..	,, ..	10 ,,	+	0·152	2·23	..	..	..	..
11.11.15	Hurley, 5 yrs.	9th day ..	–	Cloud	..	..	..	3·3 ,,	+	..	..	..	..	..	..
18.11.15	,, ,,	16th ,, ..	1,280 c.c,	..	..	..	..	..	+	0·152	1·945	..	..	..	..
5.11.15	Redhouse ..	7th ,, ..	500 c.c.	0·1 %	+	+	..	5 units	+	0·04	0·20	..	..	..	..
18.11.15	,, ..	20th ,, ..	(?)	Trace	Trace	–	–	20 ,,	+	0·239	..	..	..	..	..
5.11.15	Price, 5 6/12 yrs.	8th ,, ..	–	0·15 %	+	+	Uric acid ..	22·2 ,,	+	..	..	..	..	..	..
18.11.15	,, ,,	21st ,, ..	960 c.c.	Trace	..	–	–	20·0 ,,	+	0·292	2·803	..	..	0·44	..
8.11.15	Armsby, 6 yrs.	6th ,, ..	–	,,	..	..	Amorphous urates	22·2 ,,	+	..	..	..	..	..	..
11.11.15	Stein, 5 yrs. ..	2nd ,, ..	–	0·025 %	+	+	..	5 ,,	+	..	..	..	..	..	..
15.11.15	Morbury ..	1st ,, ..	200 c.c. (?)	Trace	Trace	+	..	10 ,,	+	..	..	0·834	..	0·59	..
3.12.15	Sullivan ..	,, ,, ..	–	0·15 %	+	..	Calcium oxalate	10 ,,	+	..	..	..	..	..	..
,,	Skipper, 5 yrs.	3rd ,, ..	–	0·25 %	+	+	..	2·2 ,,	+	..	..	..	..	..	..

December 1, 1915, suffering from acute nephritis His history pointed to onset of scarlet fever three weeks previously, with a rash. On November 29 there was desquamation, followed on November 30 by a sore throat and vomiting. On admission he had general desquamation of the skin, a furred tongue, infected throat, vomiting, cyanosis, and a rapid, weak pulse. The urine was scanty and contained blood and albumin. On December 2, a catheter specimen of urine was obtained and showed the following characters: Albumin 0·25 per cent, blood in quantity. Microscopically there were abundant hyaline casts, but no granular or epithelial casts were seen. There were also a large number of white blood cells. The diastatic activity amounted to 2·2 units (normal = 10 to 22·2 units). Cultures made from this urine showed no growth in $\frac{1}{10}$, $\frac{1}{100}$, or $\frac{1}{1000}$ of a cubic centimetre. The patient became progressively worse, the cyanosis and rapid weak pulse being most marked. His temperature ranged from 100° to 103° F., and pulse 96 to 140. He died on December 6 with all the signs and symptoms of uræmia.

Post-mortem examination on December 7 showed fluid in all the serous cavities. The kidneys were both enlarged and engorged with blood. On cutting, the venous engorgement was well marked, and all the features of an acute nephritis were visible. Microscopically the kidneys showed a typical acute glomerulo-tubular nephritis. The glomeruli were shrunken and the epithelium considerably damaged, whilst the tubules showed well-marked cloudy swelling. The vessels also appeared engorged with blood. All the other organs appeared natural. The cerebrospinal fluid withdrawn at the time was distinctly turbid, and gave a urea figure of 0·104 per cent (normal 0·02 to 0·05 per cent.). The patient therefore died from uræmia following acute nephritis of scarlatinal origin.

The cases of scarlatinal nephritis appear to show evidence of a true acute nephritis. The absence of any organisms in the urine of these cases rather points to the fact that the nephritis is not due to any recognizable virus. The most striking feature and one difficult of explanation is the presence in the urine of such large numbers of white blood corpuscles of the polymorphonuclear type. We know of course that scarlet fever itself is associated with a polymorphonuclear leucocytosis, but I know of no observations of their appearanee in the urine, or their possible significance in this situation. Further, it appears that no data are available as to the relative frequency of these cells in the various types of

Table showing Synopsis of Characters of the "Acute Nephritis" found in France, as compared with Scarlatinal Nephritis met with in England.

	Trench nephritis	Scarlatinal nephritis
Past history ..	No history of scarlet fever ..	Rarely history of previous attack.
Symptoms :—		
Headache ..	Frequency of severe headache amongst first symptoms	Very common.
Vomiting ..	Attack often ushered in by vomiting for a few days	Vomiting—common feature.
Sore throat ..	Common feature	Very common.
Shortness of breath	Well marked	Very rare.
Signs :—		
Temperature ..	Fluctuating temperature up to 103° F.	Rise of temperature frequent at onset of nephritis.
Œdema ..	Generally localized to face or legs	Usually localized.
Duration ..	May last four to five days, sometimes longer	Rapidly clears up.
Ascites	May occur	Not common.
Bronchitis ..	Prevalent	,, ,,
Heart	Normal	Normal.
Urine reaction ..	Acid	Acid.
Albumin ..	In large quantity	In quantity.
Duration ..	Rapidly disappears in most cases	
Blood	In the form of fresh red blood cells	In quantity.
Duration ..	Tends to disappear but may persist for some time	
Microscopical characters :—		
Casts.		
Hyaline ..	Very common	Very common.
Granular ..	Present in later stages of the disease, very few in early cases	Present in later stages; very few in early cases.
Epithelial ..	Very rare	Very rare.
Fatty casts..	Uncommon	Uncommon.
White blood cells	Present in large numbers in centrifugalized deposit	Present in large numbers and persist generally after casts disappear.
Cultural characters	Invariably sterile	Invariably sterile.
Chemical characters :—		
Retention of nitrogen	±	±
Retention of chlorides	Usually in more acute cases ..	Usually in more acute cases.
Diastatic activity	Subnormal in acute cases, rises to normal during convalescence	Very low in acute cases and rises to normal in convalescence.
	Patients with low diastase index show a prolonged convalescence	Very low in acute cases and rises to normal in convalescence.
Death.		
Uræmia ..	From uræmia in some cases ..	Very low in acute cases and rises to normal in convalescence.
	Fits, convulsions, subnormal temperature; may recover	Generally do not recover.
Hæmorrhage ..	Fatal termination in hæmorrhage, almost purpuric in nature	Not so common.
Post-mortem appearances	Kidneys have typical appearance of acute nephritis, passing on to stage of large white kidney	Typical acute nephritis in cases developing this complication in the third week of the disease.
Microscopical characters	An acute glomerulo-tubular nephritis with extensive tubular damage	Acute glomerulo-tubular nephritis.

nephritis met with in civil practice. This subject is being pursued, since this is the one character in which the disease in question closely corresponds to that of scarlatinal nephritis. It is possible that the cases of toxic nephritis do not show the same urinary changes, and the presence of leucocytes may serve to distinguish these from those of an infective origin. It is of interest in this connexion to refer to a case of scarlet fever where death occurred on the sixth day of the disease. This patient had a septic ulcer on the throat with severe hæmatemesis on two days preceding the fatal termination. Post-mortem examination demonstrated that all the organs were very pale. The kidneys showed a number of minute hæmorrhages under the capsule, and when cut across had all the appearances of an early acute nephritis. Sections however showed a very well marked interstitial plasma-celled infiltration of the cortex of the kidney. It is important to note that no albumin was detected in the urine, and no evidence of nephritis obtained during life. The histological evidence in scarlatinal nephritis appears to be somewhat conflicting, since some writers lay particular stress upon the glomerular changes, others upon affections of the tubules. Cases are on record when the glomeruli show very little alteration, and we have the example quoted above where both glomeruli and tubules are equally affected. In my opinion a differentiation between the various lesions in the kidney in acute nephritis is probably impossible since every conceivable variety may be met with. The same remarks apply to acute nephritis produced by mineral poisoning where the lesion is said to be tubular in type. Whilst it is true that the tubules suffer the most severe damage, the glomeruli are also affected, though not so extensively.

SUMMARY AND CONCLUSIONS.

The main features of this work on acute nephritis have already been summarized by Langdon Brown, so that further discussion of such points is rendered unnecessary. The disease in question is not a "new disease" as some writers have urged, but is a true acute nephritis as shown by clinical, chemical, and histological evidence. Many of the cases exhibit evidence of extensive renal disease, characterized by the passage of quantities of blood with the urine. The disease appears to be one of comparative rarity in civil life, but prevalent in war, as seen by the records of the American Civil War, and by the fact that the German and Austrian armies have also been affected in the present War. This disease

is, therefore, not merely accidental, but represents one with similar symptoms distributed over a large area, and suggests that there is some common causal agent responsible. Having established the fact that the condition is one of true acute nephritis by the microscopical characters of the urine, and tests for renal permeability, certain well-known causes of acute nephritis in civil practice had to be investigated. Thus the question of mineral poisons, intestinal toxæmia, direct bacterial infection (pyelonephritis), and septic foci have been excluded, as will be seen from the evidence adduced above. There are, however, certain advocates of the theory that typhoid inoculation is responsible, particularly certain German writers.[1] It is very difficult to find any facts to support such a contention, particularly as bacilluria is only present in a very few cases, and we have no evidence of previous attacks of dysentery, paratyphoid or typhoid fever. The histological evidence does not support the view that the renal changes are set up either by an ascending infection or by direct blood infection, and therefore such a view appears to be merely hypothetical. Again, we hear statements to the effect that many of the patients may have had previous kidney changes as the result of scarlatina or other diseases, particularly in alcoholics, and an acute attack has been brought on by exposure and "chill." Suffice it to say that very few cases of this nature have come under my notice, and these have been excluded from this paper, so that not a single case recorded here has ever had a history of any previous attack of nephritis, and no history of scarlet fever. There seems to be little doubt that the acute nephritis is brought on by exposure to cold, but that some infective agent is responsible for the kidneys being attacked. The results recorded above of an investigation of scarlatinal nephritis are of interest in this connexion, especially as the two forms of nephritis bear a close resemblance to one another. The writer would not, however, wish to imply that he regards the outbreaks in France as scarlatinal in origin, but simply brings forward this evidence to support an infective origin of the disease. The animal experiments, though certainly inconclusive, point the way to a possible origin of the disease in a filterable virus, and much further work is required before this view can be definitely established. We know that the ultramicroscopic organisms are capable of passing through filters, and

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[1] "Discussion on War Nephritis," K.k. Gesellsch. der Aerzte in Wien, *Wien. Med. Woch.*, 1915, lxv, 1634.

are easily destroyed at a temperature of 55° C., whereas toxic substances remain unaffected. In the animal experiments recorded in this paper such results have been obtained in acute cases, but the observations are too few in number to warrant any definite statement. It is hoped that future work upon these lines may establish the point of entrance of such a virus, and also its influence upon the kidney. Presumably the kidney may hold back such organisms, and filtered extracts of kidneys from cases dying of this disease will be used if possible.

The variability in the duration of the disease and the tendency to remission and relapse are common features, and this is explained by the varying degree of renal damage met with. The low diastase content of the urine appears to provide evidence of extensive renal damage, which accounts for the long duration of the acute stage and the persistence of symptoms. This low diastase sometimes persists after the albuminuria has ceased, and such patients were found to be subject to frequent relapses. Patients with a low diastase value in the early stages showed a rise to normal as they improved. The slight cases on the other hand showed normal values from the first, and these rapidly recovered. The test, therefore, appears to have a definite value in prognosis, and this is a matter of importance in an epidemic of this nature. The ultimate prognosis of most of the cases is favourable, but a number are subject to remission and relapse necessitating a long stay in hospital. Again, several patients who have been discharged from hospital as cured return again directly the climatic conditions become unfavourable. This liability to relapse must be still more prevalent when such patients are on active service. The above observations on the diastatic activity of the urine should apply to all such cases, and, since it can be so easily carried out, is recommended for that purpose.

The evidence adduced in this paper therefore suggests that an infective agent is the cause of the disease, and this possibly acts on the kidneys of cases who are susceptible. As a predisposing cause for the entrance of such an infection, cold and exposure no doubt play a prominent part. The frequency with which the nephritis occurred in March and April, and the later months of the year 1915, combined with almost identical data obtained from the records of the epidemic of acute nephritis in the American Civil War, lend additional support to such a view. It must be observed, however, that these records, both of the American Civil War and those obtained during this present War, demonstrate that, although

cold and exposure may be the determining factor in the onset of the disease in epidemic form, there is no evidence whatever to show that it is in any way responsible for its continuance. Some other factor must therefore be looked for, and in my opinion this is supplied by regarding the disease as infective in nature.

The degree of affection of the glomeruli, the chemical tests, and post-mortem evidence also point to such an origin. The severe and sometimes intractable hæmaturia that occurs in this disease, together with the other characteristic symptoms, such as shortness of breath at the beginning of the attack, are also in favour of this cause. The future only will decide as to the exact nature of the infective agent and its seat of entry into the body.

CONCLUSIONS.

(1) The chemical changes in the urine, both as regards the diastatic activity and the nature of the proteins present, point to the condition being a true acute nephritis.

(2) The estimation of the diastatic activity may be employed to differentiate the severity of the disease, and also the prognosis.

(3) The low diastase values met with in the severe cases correspond with retention of non-protein nitrogen in the blood and cerebrospinal fluid.

(4) The possible origin of the disease as a result of intestinal toxæmia or mineral poisoning is excluded.

(5) There is no evidence of a recognizable bacterial infection either in the blood or urine.

(6) The urine of cases of acute nephritis possesses an increased toxic action upon animals, but the nature of this agent has not been determined.

(7) Although the disease has not been transmitted to animals, the experiments demonstrate that a definite illness can be induced in rabbits and monkeys, commencing eight days after the injection of urine from acute cases, and in some with a fatal termination on the tenth day.

(8) The experiments afford evidence that there is an ultra-microscopic organism present in the urine of early cases, which appears to be responsible for these ill-effects following injection of the urine into animals.

(9) The investigation of scarlatinal nephritis brings out many points of interest and serves to demonstrate that we are dealing with acute inflammatory changes in the kidney in both diseases.

A PLEA FOR A COLLECTIVE STUDY OF TETANUS.

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"I THINK it is an unfortunate mistake to give antitetanus serum prophylactically until the serum is as abundant as the water in the Channel. On the other hand, at the first warning—stiffness, pain, rigidity, either in jaw, neck, back, or limbs—it should be given whether in doubt or not."

"In regard to the therapeutic effect of antitetanic serum the evidence would go to show that the action is not well marked."

"With regard to antitetanic serum, there seems little evidence as to its value, but everyone agrees that it ought to be given as it does no harm."

Such are some of the opinions as to the curative value of tetanus antitoxin which have been expressed since the War began. The first evinces a certain amount of faith in serum treatment, the second brings in a verdict of "not proven," while the third damns it with the faint praise of harmlessness.

This conflict of opinion is not confined to the antitoxin treatment of tetanus, but is apparent concerning every method of treatment that has been used for tetanus.

One man swears by Baccelli's phenol treatment; another says phenol is of no use whatever but that sulphate of magnesium has given him excellent results; a third pins his faith on large doses of chloral (ten to twenty grammes in twenty-four hours); a fourth combines one or more of the previous three with the administration of some other drug or drugs. If a number of cases come under the care of the same surgeon it is not unusual to find that more than one method is made use of. As examples we may take two series of cases, those of Hochhaus and those of Joly.

Hochhaus (1914) had forty-six cases of tetanus under his care in hospitals at Cologne. He used Behring's serum and gave a daily dose of 100 units (4,000 U.S.A. units), the first, as a rule, intraspinally and the others subclavicular, as owing to marked opisthotonos the intrathecal injection was not always possible, even under ether. In a number of cases the injection was made in the first twenty-four hours. All had also symptomatic treatment. Twenty-two cases, mostly severe, with an incubation period up to

ten days, were treated with these doses. He noticed that after intraspinal injection there was often some fever and rather severe headache.

Eleven cases had at least three doses of 100 units (4,000 U.S.A. units), most of them more, even up to 1,200 units (48,000 U.S.A. units) seven died. Two cases had two doses of 100 units (4,000 U.S.A. units), two died. Nine cases had one dose of 100 units (4,000 U.S.A. units), five died. In very severe cases the serum appeared to have no effect, nor did other treatment. Seventeen cases had serum *plus* $MgSO_4$ *plus* morphia, and twelve died; fifteen cases had phenol (0·9 gramme to 1·5 grammes in twenty-four hours), and nine died. Phenol alone was only useful in mild cases, in others it was necessary to supplement it with morphia or chloral.

When magnesium sulphate[1] was injected subcutaneously there were not infrequently local subcutaneous hæmorrhages which were followed by abscesses. He recommends that a five per cent to ten per cent solution of glucose should be given intravenously to sustain the strength.

Joly (1915) had twenty-five cases of tetanus under his observation in a hospital at Brest between August 31 and December 31, 1914. Seven cases had *no* serum, *only* phenol, and seven died; seven cases had *only* serum, *no* phenol, and five died; and eleven cases had serum *plus* phenol, and five died.

The serum was given subcutaneously and intravenously. Those that recovered had not more than forty cubic centimetres to eighty cubic centimetres. He also used chloral (not more than twelve grammes in twenty-four hours), bromide, pyramidon, valerian and veronidia. Believing that the cardio-renal apparatus plays a most important rôle in tetanus, and that though the disease may be in the nervous system yet the danger is in the kidneys and heart, he gave also digitalis, strophanthus, squill, vin de Trousseau, diuretic drinks, Vichy-Célestins. In the asphyxial crises he found morphia, camphor in oil, ether and very frequent inhalations of oxygen of value. All the deaths were due to asphyxia owing to contraction of the muscles of respiration.

Post mortem there was intense congestion of all organs, but especially of the kidneys and liver. He says that very early in the attack there may be slight polyuria but later the secretion

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[1] Heile (1915) states that at autopsy, after repeated intraspinal injections of $MgSO_4$ he found the pia mater reddened and chronically inflamed and the cord firmer here than elsewhere.

diminishes. If the urine amounts to 500 cubic centimetres in twenty-four hours there is a chance of recovery. From the time the urine becomes abundant the tetanic symptoms ameliorate.

Besides these mentioned above, other drugs have been administered, e.g., chloretone, scopolamine, paraldehyde, chloroform, salol, luminal, luminal natrium, lantol ("colloidal" rhodium) and "colloidal" iodine, and no one of them all has emerged from the trials ahead of the others. This is only in accordance with previous experience, for Surgeon-General F. Stricker (1914), who was concerned in the compilation of the "Medical History of the War of 1870-71," states that in that campaign the mortality from tetanus was high (of 324 cases 295, 90·49 per cent, died), and almost every army surgeon spoke against the use of opiates, as in spite of large doses the proper condition of narcosis was not reached. He himself, for instance, gave to one case in the course of six days 10·5 grammes of opium and 1·5 grammes of morphia without much effect on the cramps. Chloroform also mostly failed. Chloral when given in sufficiently large doses seemed to do good, but there was no large number of cases treated with these doses, for the surgeons, as a rule, did not follow Liebreich's recommendation as to its administration.

Further, some say that Turkish baths, hot packs, or frequent hot baths of about twenty minutes duration (at first about 99° F. and raised up to 104° F.) have a relaxing and calming effect, enabling the patient to take nourishment while in the bath; others say that patients find ice-bags grateful and comforting.

All this means that the present methods of treating declared tetanus are unsatisfactory and that it is incumbent on us to make a collective study of the disease and endeavour to systematize the treatment.

Now there is general agreement with regard to certain points, namely:—

(1) That the patient should be kept as free as possible from all disturbing stimuli: room darkened, mattress on the floor, patient's head wrapped in cotton wool, thick carpets, non-rustling dresses and felt slippers for nurses, etc.

(2) That every means should be taken to sustain the patient's strength. When enough food cannot be given by the mouth or rectum, it has been suggested to give a solution of glucose intravenously. Barbee's (1914) experience might possibly prove useful on occasion. After careful observation of 150 cases, he thinks

that sugar solution by proctoclysis is a valuable adjunct in post-operative treatment. Sugar water is rapidly absorbed by the rectum. Fifteen grammes of sugar to one litre of water should be administered by the (Murphy) drop method—thirty to forty drops per minute. The rate may be increased or diminished according to the patient's need. Three quarts may be thus given in twenty-four hours. In two cases of gastro-enterostomy the solution ran continuously for seven days. No other form of nourishment was given. The patients did not complain of the slightest hunger, kept their weights, and no sugar appeared in the urine.

(3) That the only *specific* treatment is by means of tetanus antitoxin.

(4) That whatever method of treatment is adopted, *it must, to give good results, be begun at the earliest possible moment.*

That the specific treatment by means of tetanus antitoxin can have an effect upon the disease has been demonstrated experimentally, but before referring to this in detail it may be as well just to mention our experience with other methods of treatment.

Magnesium Sulphate.—We have tried subcutaneous injections of a saturated solution of this salt in cases of tetanus in the horse, but we cannot say that they had any effect upon the course of the disease. We have combined them with potassium bromide and have pushed the treatment until deep sleep ensued, but the result was not satisfactory. Sudden death when everything is going on well is not uncommon during an attack of tetanus in the horse, but we have got the impression that it is more frequent when magnesium sulphate has been given. It is true that our experience is limited to a few cases, but the conclusion we have come to is that, unless the treatment is pushed, it is without effect, and when pushed it seems to entail too great risks.

As regards phenol and iodine my colleague, Dr. S. S. Zilva, and I have carried out a few experiments on guinea-pigs.

Phenol.—Baccelli's treatment by means of subcutaneous injections of phenol has been tried for many years, but it has not proved itself reliable. He recommends (1911) that in the human subject not less than one gramme of phenol should be given daily. We have used relatively larger doses than this. Thus on November 8, at 3.45 p.m., five guinea-pigs weighing respectively 340, 345, 345, 345 and 350 grammes each, received 0·000006 gramme of tetanus toxin U.S.A.$_6$ beneath the skin of the abdomen. On November 9, at 9.30 a.m. and at 3 p.m., each animal received subcutaneously four cubic centimetres of a 0·2 per cent solution of

phenol. On November 10 all the animals showed slight lateral curvature of the spine due to muscular spasm. The doses of phenol were repeated morning and afternoon. November 11, two animals had died during the night, and the other three had severe tetanus and died during the day.

A further experiment was carried out with larger doses of phenol. On November 16, at 3.15 p.m., five guinea-pigs, weighing respectively 375, 340, 350, 340 and 340 grammes each, received beneath the skin of the abdomen 0·000006 gramme of tetanus toxin U.S.A.$_6$. On November 17, at 9. 30 a.m. and at 3 p.m., ten cubic centimetres of a 0·2 per cent solution of phenol were injected subcutaneously in each case. On November 18 all had slight lateral curvature of the spine. The doses of phenol were repeated at 9·30 a.m. and at 3 p.m. November 19 : One animal (340 grammes) had died during the night. The other four each received an injection of phenol at 9.30 a.m. All except the 375 grammes animal died during the day. November 22: The curvature of the spine was increased, and two legs were affected. November 23: No phenol given since November 19. The animal seems on the road to recovery, though it has moderately severe tetanus. December 6: Slight curvature of the spine, but otherwise the animal is quite well.

Now four cubic centimetres of a 0·2 per cent solution represents eight milligrammes of phenol, and this for a guinea-pig of 350 grammes weight corresponds to about 1·5 grammes of phenol for a man of eleven stone. This amount given twice a day satisfies Baccelli's postulate, and yet it had no effect in even prolonging life. When double the dose was given, only one animal out of five lived, and to this result no weight can be attached, as it is not unusual for one animal of a series to survive under any treatment when only one minimal lethal dose of toxin is given.

As a control experiment each of three guinea-pigs, the weights of which were between 360 grammes and 375 grammes, received each morning and each afternoon ten cubic centimetres of a 0·2 per cent solution of phenol until nine doses had been given. They remained quite well. Besides, according to Worth Hale (April, 1913), the usual minimal lethal dose of phenol for a guinea-pig is 0·0005 gramme per gramme of body-weight. The doses we gave each day were well within the lethal limit.

Under the conditions of experiment phenol may be said to have failed completely as a curative agent in the treatment of tetanus.

Iodine.—The well-known fact that iodine has the power of so

modifying tetanus toxin as to render it non-toxic, and that such modified toxin is used to immunize horses for the production of tetanus antitoxin, would very naturally lead one to think that iodine might be of value in the treatment of tetanus.

Auregan (1915) published a series of cases in which he had given serum and also intramuscular injections of "colloidal" iodine, and he thought that the iodine had a beneficial effect.

In these laboratories we have given subcutaneous injections of various preparations of "colloidal" iodine, among them being iodargol and a combination of iodine and starch, in experimental tetanus in the guinea-pig following the injection of one minimal lethal dose of tetanus toxin. The result has been most unsatisfactory. As in the case of phenol one animal out of a series might survive, but these survivals were so irregular that they could not be put down to the effect of the iodine. Nor was the effect of serum treatment enhanced by injections of iodine. It may be that the preparations we used were different from that used by Auregan, or that subcutaneous are not as good as intramuscular injections, but, at any rate, we did not obtain results which were encouraging enough to induce us to continue our experiments.

We can now pass on to—

Tetanus Antitoxin.—The following experiments were carried out before the War began. At the time it was purposed to extend them and make them more complete, but the supervention of hostilities brought our studies to an end.

The object we had in view was to ascertain whether the *development* of an attack of tetanus could be prevented by giving antitoxin several hours after the subcutaneous injection of a lethal dose of toxin and when one might consider that the incubation period was just coming to an end or had just ended. The toxin used was a standard dry test toxin used in the standardization of antitetanic serum and was supplied by Dr. J. F. Anderson, Director of the Hygienic Laboratory, U.S. Public Health Service. I am very glad to have this opportunity of tendering him my most sincere thanks for this and many other kindnesses. The minimal lethal dose of this toxin when injected beneath the skin of the abdomen was 0·000006 gramme, and the test dose for the standardization of sera was 0·0006 gramme, i.e., 100 minimal lethal doses. That amount of serum which saves the life of a guinea-pig weighing 350 grammes for ninety-six hours against the test dose of toxin contains $\frac{1}{10}$ U.S.A. unit of antitoxin. One unit may therefore be said to be equivalent to 1,000 minimal lethal doses of this toxin.

The effect of injecting a single minimal lethal dose of this toxin beneath the skin of the abdomen was not noticeable until after about twenty-four hours, when there might often be detected a very slight lateral curvature of the spine. This became more pronounced usually, and the tetanus spread and involved the limbs. Death took place between the third and the sixth day. The following conventions are used in this paper :—

s.c. = subcutaneously.
i.m. = intramuscularly.
i.p. = intraperitoneally.
i.v. = intravenously.
abd. = abdomen.
S. = Sunday, when no observations were made.
– = No signs of tetanus.
t. = Tetanus, and the number of "ts" indicates the degrees of severity.
\+ = Death. The position of the + indicates approximately the time of death. A + on the line between two days means that death took place during the night.
c.s. = Curvature of the spine, only noted in special cases.

The animals were examined only once a day in the morning, and the notes represent the condition at that time.

These results are in accord with those of Dönitz as regards saving life, and they also show that in some cases by increasing the dose of antitoxin we can not only save life but even prevent the development of tetanus, provided always that we begin the treatment early. If, however, there is any delay in the giving of antitoxin then even enormous doses are of no avail. It seems also that there is a limit to the amount of antitoxin which can be made use of, for even when the blood contained *fifty U.S.A. units per cubic centimetre*, which means that there was in the body enough antitoxin to neutralize more than *one and a half million minimal lethal doses*, yet the animals succumbed to the effect of *one single minimal lethal dose*. These results also emphasize the great differences which exist in the susceptibility of different animals, and show how extremely difficult it is to judge of the worth of a method of treatment from its results in a few cases. In the two cases in which the animals lived in Experiments 14 and 15 one must give the main credit of the result rather to some idiosyncrasy of the guinea-pig than to the effect of the serum.

EXPERIMENT 1.

12.2.14	Toxin s.c. abd.	Serum s.c. abd.	14.2	15.2	16.2	17.2	18.2	19.2	20.2
350 grm.	0·000006 grm., U.S.A.$_4$	300 units antitoxin, 18½ hours later	t.	S.	tt.	tt.	ttt.	ttt.	tttt., killed.
340 ,,	,, ,,	,, ,, ,, 20½ ,, ,,	—	S.	tttt.	tttt. +	..	..	..
355 ,,	,, ,,	,, ,, ,, 22½ ,, ,,	tt.	S.	tttt.	tttt.	tttt.	ttt.	tttt., killed.
340 ,,	,, ,,	,, ,, ,, 24½ ,, ,,	tt.	S.	tttt.	tttt.	tttt.	+	..
355 ,,	,, ,,	500 ,, ,, 42½ ,, ,,	..	S. +	..	..	..	..	..

EXPERIMENT 2.

12.2.14	Toxin s.c. abd.	Serum i.p.	14.2	15.2	16.2	17.2	18.2	19.2	20.2
360 grm.	0·000006 grm., U.S.A.$_4$	300 units antitoxin, 18½ hours later	t.	S.	ttt.	tttt.	tttt.	tttt.	tttt., killed.
370 ,,	,, ,,	,, ,, ,, 20½ ,, ,,	ttt.	S.	tttt.	tttt.	tttt.	tttt.	tttt. ,,
345 ,,	,, ,,	,, ,, ,, 22½ ,, ,,	tt.	S.	tttt. +	..	..	..	..
340 ,,	,, ,,	,, ,, ,, 24½ ,, ,,	ttt.	S.	tttt.	tttt.	tttt. +	..	..
350 ,,	,, ,,	500 ,, ,, 42½ ,, ,,	..	+	..	..	..	..	..

EXPERIMENT 3.

23.2.14	Toxin s.c. abd.	Serum s.c. abd.	25.2	26.2	27.2	28.2	1.3	2.3
340 grm.	0·000006 grm., U.S.A.$_4$	1,000 units antitoxin 18 hours later	t.	tt.	tt.	tt.	S.	ttt., killed.
350 ,,	,, ,,	,, ,, ,, 20 ,, ,,	t.	tt.	tt.	tt.	S.	ttt. ,,
340 ,,	,, ,,	,, ,, ,, 22 ,, ,,	tt.	ttt.	ttt. +	..	..	..
355 ,,	,, ,,	,, ,, ,, 24 ,, ,,	t.	ttt.	tttt. +	..	..	..

EXPERIMENT 4.

23.2.14	Toxin s.c. abd.	Serum i.p.	25.2	26.2	27.2	28.2	1.3	2.3
360 grm.	0·000006 grm., U.S.A.₄	1,000 units antitoxin, 18 hours later	t.	tt.	tt.	ttt.	S.	ttt., killed.
370 ,,	,, ,,	,, ,, ,, 20 ,, ,, (not quite all i.p.)	tt.	tt.	tt.	ttt.	S.	+ ..
340 ,,	,, ,,	,, units,antitoxin, 22 hours later	tt.	ttt.	ttt.	ttt.	S.	tttt., killed.
350 ,,	,, ,,	,, ,, ,, 24 ,, ,,	t.	ttt.	tt.	ttt.	S.	tttt. ,,

In Experiments 1, 2, 3 and 4 the animals were killed because it did not seem possible they could survive. Subsequent experience, however, showed that some of them might possibly have lived.

EXPERIMENT 5.

3.3.14	Toxin s.c. abd.	Serum s.c. abd.	5.3	6.3	7.3	8.3	9.3	10.3	11.3	12.3	1.4
360 grm.	0·000006 grm., U.S.A.₄	2,000 units antitoxin, 18 hours later	t.	tt.	tt.	S.	tt.	tt.	ttt.	ttt.	All quite well.
370 ,,	,, ,,	,, ,, ,, 20 ,,	t.	tt.	tt.	S.	tt.	tt.	ttt.	tttt.	,, ,,
380 ,,	,, ,,	,, ,, ,, 22 ,,	t.	ttt.	ttt.	S.	ttt.	ttt.	tttt.	tttt.	,, ,,
380 ,,	,, ,,	,, ,, ,, 24 ,,	t.	ttt.	ttt.	S.	tttt.	ttt.	tttt.	ttt.	,, ,,

EXPERIMENT 6.

3.3.14	Toxin s.c. abd.	Serum i.p.	5.3	6.3	7.3	3.8	9.3	10.3	11.3	12.3	1.4
340 grm.	0·000006 grm., U.S.A.₄	2,000 units antitoxin, 18 hours later	t.	ttt.	ttt.	S.	ttt.	ttt.	ttt.	tttt.	All quite well.
360 ,,	,, ,,	,, ,, ,, 20 ,,	tt.	tttt.	ttt.	S.	tttt.	tttt.	tttt.	tttt.	,, ,,
345 ,,	,, ,,	,, ,, ,, 22 ,,	t.	tt.	ttt.	S.	ttt.	ttt.	ttt.	ttt.	,, ,,
370 ,,	,, ,,	,, ,, ,, 24 ,,	ttt.	tttt.	tttt. +	..	..	..	..	..	..

Experiment 7.

11.3.14	Toxin s.c. abd.	Serum s.c. abd.	13.3	14.3	15.3	16.3	17.3	18.3	19.3	21.3	24.3	1.4
340 grm.	0·000006 grm., U.S.A.,	4,000 units antitoxin, 18 hours later	tt.	tt.	S.	ttt.	tt.	tt.	tt.	t.	Slt. t.	Quite well.
340 ,,	,, ,,	,, ,, ,, 20 ,,	t.	tt.	S.	ttt.	tttt.	ttt.	ttt.	tt.	t.	,,
345 ,,	,, ,,	,, ,, ,, 22 ,,	tt.	tttt.	S.	tttt.	tttt.	tttt.	tttt.	ttt.	tt.	,,
345 ,,	,, ,,	,, ,, ,, 24 ,,	tt.	ttt.	S.	ttt.	ttt.	tttt.	ttt.	tt.	t.	,,

Experiment 8.

11.3.14	Toxin s.c. abd	Serum i.p.	13.3	14.3	15.3	16.3	17.3	18.3	19.3	21.3	24.3	1.4
340 grm.	0·000006 grm., U.S.A.,	4,000 units antitoxin, 18 hrs. later	t.	tt.	S.	ttt.	tt.	tt.	tt.	t.	—	Quite well.
340 ,,	,, ,,	,, ,, ,, 20 ,,	t.	ttt.	S.	ttt.	tt.	tt.	tt.	tt.	—	,,
360 ,,	,, ,,	,, ,, ,, 22 ,,	t.	t.	S.	t.	tt.	t.	t.	Slt. stiff	Better	,,
340 ,,	,, ,,	,, ,, ,, 24 ,,	t.	tt.	S.	tt.	ttt.	ttt.	tttt.	ttt.	t.	,,

It is to be noted that while the animals of Experiments 5 and 6, in which the dose was 2,000 units, required four weeks to regain their health, the animals of Experiments 7 and 8, in which the dose was 4,000 units, were quite well at the end of three weeks.

The fact that the intraperitoneal route offers no advantage over the subcutaneous was noted by other observers several years ago (*cf.* Descos and Barthélemy, *C.R. Soc. Biol.*, 1902, pp. 1055 and 1057.

Experiment 9.

9.6.14	Toxin s.c. abd.	Serum s.c. abd., 24 hours late	11.6	12.6	13.6	14.6	15.6	16.6	20.6	29.6	
340 grm.	0·000006 grm., U.S.A.$_4$	6,000 units antitoxin	—	—	—	S.	—	—	—	Quite well	..
345 ,,	,, ,,	,, ,, ,,	—	—	—	S.	—	—	—	,,	..
340 ,,	,, ,,	,, ,, ,,	—	t.	t.	S.	t.	t.	—	,,	..
345 ,,	,, ,,	,, ,, ,,	—	—	—	S.	—	—	—	,,	..
15.6.14			17.6	18.6	19.6	20.6	21.6	22.6	23.6	24.6	6.7
340 grm.	0·000006 grm., U.S.A.$_5$[1]	,, ,, ,,	—	—	—	—	S.	—	—	—	Quite well.
340 ,,	,, ,,	,, ,, ,,	—	—	—	—	S.	—	—	—	,,
340 ,,	,, ,,	,, ,, ,,	—	c.s.	c.s.	c.s.	S.	tttt. +	..	..	..
350 ,,	,, ,,	,, ,, ,,	—	—	—	—	S.	—	—	—	,,
340 ,,	,, ,,	,, ,, ,,	—	—	?	c.s.	S.	tt.	t.	—	,,
340 ,,	,, ,,	,, ,, ,,	—	c.s.	c.s.	,,	S.	tttt. +	..	..	..

[1] U.S.A.$_5$ was merely another sample of the same toxin as U.S.A.$_4$

Experiment 10.

22.6.14	Toxin s.c. abd.	Serum s.c. abd., 25 hours late	24.6	25.6	26.6	27.6	28.6	29.6	30.6	2.7	13.7
340 grm.	0·000006 grm., U.S.A.$_5$	12,000 units antitoxin	—	tt. c.s.	c.s.	t. c.s.	S.	tt. c.s.	t. c.s.	c.s.	Quite well.
,, ,,	,, ,,	,, ,, ,,	t.	ttt.	ttt.	ttt.	S.	Killed[1]	..	..	..
,, ,,	,, ,,	,, ,, ,,	tt.	tttt.	tttt.	tttt. +	..	..	..	..	..
,, ,,	,, ,,	,, ,, ,,	—	—	—	—	S.	—	—	—	Quite well.
,, ,,	,, ,,	,, ,, ,,	—	—	—	—	S.	—	—	—	,,
,, ,,	,, ,,	,, ,, ,,	—	tt.	tt.	tt.	S.	tt.	tt.	c.s.	,,
,, ,,	,, ,,	,, ,, ,,	t.	ttt.	ttt.	tttt.	S.	Killed[1]	..	..	..
,, ,,	,, ,,	,, ,, ,,	—	tt.	tt.	tt.	S.	tt.	tt.	c.s.	Quite well.
,, ,,	,, ,,	,, ,, ,,	—	tt.	t.	tt.	S.	tt.	ttt.	,,	,,
,, ,,	,, ,,	,, ,, ,,	t.	c.s.	c.s.	t. c.s.	S.	c.s.	c.s.	,,	,,

[1] After death the blood of these guinea-pigs was mixed in equal quantities and tested for antitoxin. It contained 7·5 units per cubic centimetre.

Experiment 11.

9.6.14	Toxin s.c. abd.	Serum s.c., 30 hours later	11.6	12.6	13.6	14.6	15.6	16.6	20.6	29.6		
340 grm.	0·000006 grm., U.S.A.$_5$	6,000 units antitoxin	–	–	–	S.	–	–	–	Quite well	..	..
340 ,,	,, ,, ,,	,, ,, ,,	t.	tt.	tt.	S.	tt.	c.s.	c.s.	,, ,,	..	..
340 ,,	,, ,, ,,	,, ,, ,,	t.	tt.	tt.	S.	ttt.	..	–	,, ,,	..	..
345 ,,	,, ,, ,,	,, ,, ,,	–	–	–	S.	–	–	–	,, ,,	..	..
15.6.14			17.6	18.6	19.6	20.6	21.6	22.6	23.6	24.6	26.6	2.7
340 grm.	,, ,, ,,	,, ,, ,,	–	tttt.	–	c.s.	S.	t. c.s.	c.s.	c.s.	c.s.	Quite well.
340 ,,	,, ,, ,,	,, ,, ,,	–	c.s.	–	c.s.	S.	,,	tt. c.s.	tttt. c.s.[1]	,,	Almost well.
355 ,,	,, ,, ,,	,, ,, ,,	–	–	–	–	S.	–	–	–	–	Quite well.
360 ,,	,, ,, ,,	,, ,, ,,	tt.	tttt. +	..	..	..	..	..	..	..	..
340 ,,	,, ,, ,,	,, ,, ,,	–	–	ttt.	+	..	..	..	..	..	..
340 ,,	,, ,, ,,	,, ,, ,,	t.	tttt.	tttt.	tttt. +	..	..	..	..	..	..

[1] On this morning this animal was thought to be dead and the attendant was going to remove it from the cage when he noticed a slight movement of respiration. He therefore left it alone and it recovered in a surprisingly short time considering the condition it had been in. We should not, in the face of this experiment, consider any case as hopeless.

Experiment 12.

9.6.14	Toxin s.c. abd.	Serum s.c. abd., 48 hours later	11.6	12.6	13.6	14.6	15.6	16.6
340 grm.	0.000006 grm., U.S.A.$_5$	6,000 units antitoxin	tt.	tttt. +	..	..	..	..
,, ,,	,, ,, ,,	,, ,, ,,	tt.	tttt. +	..	..	..	..
,, ,,	,, ,, ,,	,, ,, ,,	tt.	+	..	..	..	..
,, ,,	,, ,, ,,	,, ,, ,,	tt.	tttt. +	..	..	..	..

EXPERIMENT 13.

15.6.16	Toxin s c. abd.	Serum s.c. abd., 48 hours later	17.6	18.6	19.6	20.6	21.6	22.6
360 grm.	0·000006 grm., U.S.A.₅	12,000 units antitoxin	c.s.	ttt.	ttt.	+	..	..
340 ,,	,, ,, ,,	,, ,, ,,	,,	tttt.	tttt. +	..	..	..
,, ,,	,, ,, ,,	,, ,, ,,	,,	t.	ttt.	tttt. +	..	..
,, ,,	,, ,, ,,	,, ,, ,,	,,	tt.	ttt.	tttt.	+	..
,, ,,	,, ,, ,,	,, ,, ,,	t.	–	tttt.	tt.	S. +	..
345 ,,	,, ,, ,,	,, ,, ,,	c.s.	ttt.	+	..	..	..

EXPERIMENT 14.

9.6.14	Toxin s.c. abd.	Serum s.c. abd. 54 hours later	11.6 10 a.m. before antitoxin	12.6	13.6	14.6	15.6	16.6	20.6	29.6
340 grm.	0·000006 grm., U.S.A.₅	12,000 units antitoxin	tt.	ttt.	–	S.	–	–	–	Quite well.
345 ,,	,, ,,	,, ,, ,,	ttt.	ttt.+	..	S.	..	..	..	..
340 ,,	,, ,,	,, ,, ,,	ttt.	ttt.	+	..	..	..	..	..
340 ,,	,, ,,	,, ,, ,,	tt.	tt.	+	..	..	..	..	..

EXPERIMENT 15.

15.6.14	Toxin s.c. abd.	Serum s.c. abd. 54 hours later	17.6 4 p.m. before antitoxin	18.6	19.6	20.6	21.6	22.6	23.6	24.6	26.6	27.6
340 grm.	0·000006 grm., U.S.A.₅	18,000 units antitoxin	ttt.	ttt.+	..	..	..	..	..	..	..	..
350 ,,	,, ,,	,, ,, ,,	tttt.	+	..	..	..	..	..	..	..	..
360 ,,	,, ,,	,, ,, ,,	tt.	tt.	t.	t.	S.	tt.	tt.	t.	–	Quite well.
340 ,,	,, ,,	,, ,, ,,	ttt.	tttt.+ *	..	..	..	..	..	..	..	..
340 ,,	,, ,,	,, ,, ,,	ttt.	ttt.+	..	..	..	..	..	..	..	..
345 ,,	,, ,,	,, ,, ,,	ttt.	tttt.+ *	..	..	..	..	..	..	..	..

* Blood was taken from these two animals after death, mixed in equal quantities, and the serum tested for antitoxin. It was found to contain 50 U.S.A. units per cubic centimetre.

Now the dose of 6,000 U.S.A. units for a guinea-pig of 350 grammes weight represents, when calculated according to body-weight only, a dose of about 1,200,000 U.S.A.[1] units for a man of eleven stone. Man is said to be as susceptible as the horse, and the horse is twice as susceptible as the guinea-pig, and so, if susceptibility is taken into account, the dose would be still larger.

It must be remembered that in these cases the serum was given subcutaneously. By the other routes the antitoxin comes into play more quickly, and a smaller dose might be effective. Unfortunately, as mentioned above, the outbreak of hostilities prevented us doing any intramuscular or intravenous experiments. But in order to draw attention to a special point it may be as well to mention a case of tetanus in the horse which was treated unsuccessfully with antitoxin given intramuscularly and intravenously. At the time this case occurred we were comparing various methods of immunizing horses against tetanus in the endeavour to find out the safest and quickest method.

The mare "Rosebud" was given intramuscular injections of toxin mixed with antitoxin, on the dates and in the doses detailed below. The minimal lethal dose of the toxin used was $\frac{1}{4000}$ cubic centimetre for a guinea-pig of 350 grammes weight. The serum used was that of the horse "Metchnikoff," and the titre was 100 U.S.A. units of antitoxin per cubic centimetre. The toxin and serum when evaluated one against the other gave the following result:—

One cubic centimetre toxin plus $\frac{1}{100}$ cubic centimetre serum = no signs of tetanus. One cubic centimetre toxin plus $\frac{1}{150}$ cubic centimetre serum = death on eighth day.

"*Rosebud.*"—February 2: 1 cubic centimetre toxin plus 1 cubic centimetre serum intramuscularly; February 7: 1 cubic centimetre toxin plus $\frac{1}{2}$ cubic centimetre serum intramuscularly; February 12: 1 cubic centimetre toxin plus $\frac{1}{5}$ cubic centimetre serum intramuscularly; February 17: 1 cubic centimetre toxin plus $\frac{1}{10}$ cubic centimetre serum intramuscularly; February 23: 1 cubic centimetre toxin plus $\frac{1}{20}$ cubic centimetre serum intramuscularly; February 28: 1 cubic centimetre toxin plus $\frac{1}{50}$ cubic centimetre serum intramuscularly; March 5: 1 cubic centimetre toxin plus $\frac{1}{100}$ cubic centimetre serum intra-

[1] Compare this dose with the dose of 500 to 1,000 U.S.A. units which has been found to be sufficient for prophylactic purposes in the majority of cases. It is somewhat more economical to use serum prophylactically than curatively.

muscularly; March 10: 1 cubic centimetre toxin plus $\frac{1}{150}$ cubic centimetre serum intramuscularly; March 16: 2 cubic centimetres toxin plus $\frac{1}{75}$ cubic centimetre serum intramuscularly; March 21: 4 cubic centimetres toxin plus $\frac{2}{75}$ cubic centimetre serum intramuscularly; March 26: 8 cubic centimetres toxin plus $\frac{4}{75}$ cubic centimetre serum intramuscularly; March 31: 16 cubic centimetres toxin plus $\frac{8}{75}$ cubic centimetre serum intramuscularly; April 4: 30 cubic centimetres toxin plus $\frac{1}{5}$ cubic centimetre serum intramuscularly; April 9: 50 cubic centimetres toxin plus $\frac{1}{3}$ cubic centimetre serum intramuscularly; April 14: 100 cubic centimetres toxin plus $\frac{2}{3}$ cubic centimetre serum intramuscularly; April 20: 200 cubic centimetres toxin plus 1 cubic centimetre serum intramuscularly. April 25: Sample of blood taken; titre = $\frac{1}{10}$ unit per cubic centimetre 50 cubic centimetres intramuscularly. April 29: Tetanus localized to one side of the neck, but only slight; 7 a.m., 20,000 U.S.A. units intravenously; 2 p.m., 15,000 U.S.A. units intramuscularly. April 30: Neck turned to off-side, muscles stiff; 15,000 units intravenously, 15,000 units intramuscularly. May 1: Neck turned more round, 30,000 units subcutaneously. May 2: Much the same; 15,000 units intramuscularly. May 3: Appears very tired; head more round; 30,000 units subcutaneously; 2 ounces pot. brom. in enema; lay down and got up without help; when lying down on near side the head and neck seemed quite straight; later lay down and did not get up. May 4: 30,000 units subcutaneously; 1 ounce pot. brom. in enema. May 5: Died.

There were never any spasms of the legs, or body, or tail. The muscles of the jaws were quite free. Food was well taken until May 4. Urine and fæces passed freely. Twice a day 1 ounce of $MgSO_4$ was given in an enema to keep the bowels open, as otherwise constipation is apt to cause trouble.

The result of this case was distinctly disappointing, for we have here a case of purely local tetanus, as far as we can judge, due to the introduction of a definite amount of toxin. At the first sign of trouble antitoxin was given intravenously and intramuscularly, in an amount sufficient to neutralize twice over all the toxin which had been given during two and three-quarter months. Almost as much antitoxin was given next day, and the amount of antitoxin given in all during the six days would have sufficed to neutralize 100 times the total amount of toxin which had been injected. And yet it appeared to have no effect upon the course of the disease. We have had more than one case of local tetanus in which

antitoxin had no apparent effect, and the peculiarity about these cases was that though the tetanus remained localized throughout, and there was never even a suspicion of trismus, or of general spasm, and though the animals took their food well, yet they seemed each day to grow more tired until they seemed too tired to stand up. Then they lay down and in spite of our efforts died.

The failure of treatment in these cases is very puzzling. Some light may be thrown on the problem by the result of an experiment performed by Permin (1913).

May 9: Rabbit, 2,650 grammes. I.m. injection of 2·65 cubic centimetres of tetanus toxin into left thigh, and of one cubic centimetre toxin into left arm; followed by three units (German) of antitoxin intravenously.	May 9: Rabbit, 2,550 grammes. I.m. injection of 2·55 cubic centimetres of tetanus toxin into left thigh, and of one cubic centimetre toxin into left arm; followed by three units (German) of antitoxin intraspinally. The rabbit was then fixed for half an hour with the head lower than the body.

Note.—One German unit = 40 U.S.A. units.

May 10: Slight tetanus in both limbs.	May 10: No tetanus.
May 11: Tetanus.	May 11: No tetanus.
May 12: Severe tetanus.	May 13: No tetanus.
May 13: Dead.	May 15: No tetanus.

From this it would seem that if the toxin be injected intramuscularly even intravenous injections of antitoxin are without effect, and that the only way to combat "intramuscular toxin" is by means of "intraspinal antitoxin." This would quite explain the failure of serum in the case of the mare "Rosebud," but it cannot be the whole story, for we have had cases of tetanus in the horse following intramuscular injections of toxin in which the tetanus did not remain localized, but spread to the body and head—in one case the jaws were tightly closed for fourteen days—and was much more severe than in "Rosebud's" attack, and yet they yielded to treatment with serum i.m. and bromide, and ended in complete recovery.

Permin, from further experiments, found that with the dose of toxin employed, antitoxin had to be given intraspinally within six hours of the toxin in order that it might have effect. In Permin's hands intraspinal antitoxin did not save life when given after tetanus was manifest, but he does not mention the amount that he

gave. On the other hand, Park and Nicoll (1914) have been more successful. They carried out some experiments with the object of comparing the value of the several routes, and their results are so important that one feels one must quote Experiment 4 in full :—

Experiment 4.—Eighteen guinea-pigs were injected into the hind leg with two minimal fatal doses of toxin proportioned to the body-weight of each. Twelve of these were given antitoxin in the amount and by the methods indicated seventeen and a half to eighteen hours later. The remaining six were held for twenty-two and a half to twenty-three hours after inoculation.

Weight, grammes	Condition of leg	Method	Amount, units	Result
290	Fairly stiff	Control	—	D. 3 days.
310	,,	,,	—	D. 3 ,,
250	Slightly stiff	H.	100	D. 8 ,,
275	Fairly stiff	H.	100	D. 4 ,,
300	,,	H.	100	D. 5 ,,
255	Slightly stiff	N.	200	D. 4 ,,
255	Fairly stiff	N.	200	D. 3 ,,
280	,,	N.	200	D. 3 ,,
285	Slightly stiff	N.	200	D. 3 ,,
255	Stiff	Sp.	10	Discharged 30 days, normal.
275	Fairly stiff	Sp.	10	Discharged 30 days, normal, drags leg.
320	,,	Sp.	10	Discharged 30 days, normal, drags leg.

H. = Intracardially. Sp. = Intraspinally.
N. = Intravenously. D. = Died.

Six given antitoxin twenty-two and a half to twenty-three hours after toxin :—

Weight, grammes	Condition of leg	Method	Amount, units	Result
300	Stiff	H.	100	D., five days.
325	,,	H.	200	D., four days.
350	,,	H.	200	D., four days.
285	,,	Sp.	50	Discharged, thirty days.
325	,,	Sp.	50	D., five days.
259	,,	Sp.	50	Discharged, thirty days.

There can be no doubt as to which route proved the most efficacious in this experiment, which confirmed previous results.

Intraspinal injections of tetanus antitoxin were first tried in the human subject many years ago, but only recently have they been used at all frequently. It is impossible to quote a case of tetanus treated solely by "intraspinal antitoxin," as serum has always been given by other routes as well. As a matter of fact, cases in which it

is definitely stated that only antitoxin was employed are extremely rare. I have only come across one. Holub (1903) records that a boy, aged 11, received a wound of the eyelid. Three days later there was trismus. On the eighth day ten cubic centimetres of serum were given subcutaneously, but afterwards serum was given subdurally. In eight days four subdural injections were made totalling 400 units, presumably Behring units, and therefore equal to 16,000 U.S.A. units. No other treatment was given. The boy recovered.

Park and Nicoll (*loc. cit.*) record six consecutive cases of recovery from tetanus in which intraspinal injections were made, but they do not state specifically that drugs were not also given. Their Case 2 is worth mention:—

Case 2.—Adult male. Incubation nine days. Not given treatment for twelve hours or more after stiffness of the jaw was noted, and then 1,500 units of antitoxin were given in the tissues about the wound and intraneurally, 3,500 intravenously and 300 subcutaneously; the next day 13,000 units intravenously, 8,000 intraneurally, and 7,000 subcutaneously. On the third day the patient continued to grow worse with increasing rigidity, and was given 9,000 units intravenously, 8,000 intraspinally and 7,000 units into the tissues of the wounded foot. Two days later there was noted less rigidity, and the patient was able to swallow and separate the jaws to a greater degree. On this day 7,500 units of antitoxin were given in the vein, and on the following day 5,000. The blood showed six units of antitoxin to the cubic centimetre at a time just previous to the final injection. The patient was discharged cured, after an illness of extreme severity, twenty days after the onset of the symptoms. "The intraspinal injection having been given so late in the disease cannot logically receive the credit for the patient's recovery, and yet the first improvement in symptoms was noted the day following the dosage given in this way."

It will be noticed that just previous to the final intravenous injection a sample of blood was obtained and found to contain six U.S.A. units per cubic centimetre. The patient's weight is not given, but he was an adult male, and we may assume that he weighed about eleven stone and that his blood volume was about 7,000 cubic centimetres. During the five previous days 64,000 U.S.A. units of antitoxin had been injected, and this would, if all retained, give an antitoxin content of some nine units per cubic centimetre. It would seem, then, as if thirty-three per cent of the antitoxin given had disappeared. In their Case 1 a girl, aged 10, received 52,000

U.S.A. units, and at the time of the last injection, a week from the onset of the disease, the blood contained four units per cubic centimetre.

In Kreuter's paper (1914) no mention is made that he used narcotics or sedatives in conjunction with his large doses of serum. He states that in each of six cases he gave more than 1,000 A.E. = 40,000 U.S.A. units, in all. They received respectively:—

In 5 days	1,100 A.E.	150 i.sp.	950 i.v.		Died.
„ 8 „	1,350 „	200 „	1,000 „	150 s.c.	Recovered.
„ 12 „	1,700 „	400 „	1,300 „		„
„ 12 „	1,950 „	400 „	750 „	800 s.c.	„
„ 16 „	2,200 „	600 „	1,600 „		„
„ 16 „	2,400 „	200 „	2,200 „		„

Note.—1 A.E. (Antitoxin Einheit) = 40 U.S.A. units.

His full results were:—

Incubation up to 10 days	14 cases	9 deaths	64·3 per cent mortality.
„ over „	17 „	2 „	12·2 „ „
Total	31 cases	11 deaths	35·5 per cent mortality.

It has been assumed that as no other treatment was mentioned antitoxin only was given in all these cases. They are evidence of the effect of antitoxin but not of the value of intraspinal injections over other ways of giving serum. For this we must rely on the animal experiments of Park and Nicoll. From them we see that tetanus antitoxin given by intraspinal injection is much more effective than by the other routes. A delay of four to five hours in giving antitoxin made it necessary to give five times the dose to obtain something like the same result as was secured when treatment was given earlier. This last dose would mean, calculated according to body-weight and relative susceptibility, some 20,000 U.S.A. units intraspinally for a man of eleven stone. Of course, the "individual" factor comes into play always and a smaller dose might suffice or a larger one be necessary in some cases, but one thing is certain, and that is, that we are *not wasting* serum when we inject 4,000 U.S.A. units of antitoxin.

Another reason for the use of intraspinal injections is that tetanus toxin has been found occasionally present in the cerebrospinal fluid itself.

Permin (*loc. cit.*) found the fluid toxic in three cases:—

Boy, aged 7. Incubation period, eleven days. The liquor, which was collected thirty hours after the onset of the disease, killed a mouse in a dose of one cubic centimetre. The patient recovered.

Boy, aged 8. Incubation period, twelve days. The liquor[1] was collected two days after the onset of the disease, and in a dose of 1·5 cubic centimetres caused local tetanus in a mouse. The patient died.

In another case one cubic centimetre of cerebrospinal fluid killed a mouse in eight days. The blood of this case was a little more toxic than the cerebrospinal fluid.

The only way to neutralize such toxin is to inject antitoxin into the subarachnoid space, as it has been shown that antitoxin does not pass, except in very small quantities, from the blood into the cerebrospinal fluid.

Further, tetanus toxin passing from the periphery up the nerves, either by the lymph channels or the axis cylinder, reaches and affects the motor nerve cells[1] of the spinal cord. Antitoxin in the cerebrospinal fluid is in the best position for neutralizing toxin in the cells.

Again, the work of Frazier and Peet (1914) and of Weed (1914) has shown that while the cerebrospinal fluid passes out into the circulation chiefly by the large venous sinuses, there is some absorption by the lymphatics from the perineural space along the spinal nerve roots. Spina (cited by Weed) found that with increasing pressures the lymphatic channels are opened up more easily and function more readily, and Frazier (1914) has shown that by obstructing the jugular veins the cerebrospinal pressure is raised. It is possible, therefore, that in tetanus this lymphatic absorption may be greater than normal, that antitoxin injected into the cerebrospinal fluid may pass out by this road to a greater extent than would be anticipated, and therefore is in the best position to neutralize toxin passing up the nerves.

It may, then, be said that for curative purposes the administration of tetanus antitoxin by intrathecal injection should not be omitted.

Here one may draw attention to the warning given by the observations of Frank (1914), who performed autopsies in 32 cases of tetanus. In only 4 could he say that death was due, apparently, to tetanus toxin and to nothing else. In 12 there was diffuse extensive confluent broncho-pneumonia and purulent bronchitis, in 4 there was "deglutition pneumonia," and in 12 *purulent spinal meningitis*. Frank does not mention whether

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[1] Recently Manouelian (1915) has brought forward histological evidence which, in his opinion, shows that it is the cytoplasm of the cells and not the neurofibrillary network which is affected.

lumbar puncture had been performed or not, but one has always to remember the possibility of infection occurring along the needle track. Levy (1911) is very emphatic about the site of the puncture being kept dry, as he says infection easily takes place if the skin is allowed to remain moist. No covering should be put on which prevents the escape of perspiration.

As soon as the antitoxin is injected it becomes diluted, and the extent of this dilution depends upon the amount of cerebrospinal fluid secreted.

StClair Thomson (1899) reports a series of cases in which cerebrospinal fluid escaped from the nose. The amount which ran out in twenty-four hours was not constant. It varied very much in the same case. In one instance it amounted to 560 cubic centimetres in the twenty-four hours. The average seemed to be about 300 cubic centimetres.

Frazier (1915) suggests that there are under normal conditions 60 to 120 cubic centimetres of cerebrospinal fluid, and that it is replaced every three to four hours. This would bring the daily quantity up to 360 to 960 cubic centimetres. If, then, we inject 4,000 U.S.A. units of antitoxin into the subarachnoid space, we must not expect to find more than about one unit of antitoxin per cubic centimetre of cerebrospinal fluid at the end of twenty-four hours.

Through the kindness of the authorities of the Herbert Hospital, Woolwich, I have received through Mr. K. W. Goadby, several samples of cerebrospinal fluid from cases of tetanus. The details of the examination of these samples have been published by Mr. Goadby in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October, 1915, and there is no necessity for me to give them here. It suffices to say that the amount of antitoxin present in the cerebrospinal fluid twenty-four hours after an injection of 4,000 U.S.A. units varied greatly, the lowest being about $\frac{1}{300}$ U.S.A. unit and the highest nearly 10 U.S.A. units. In one case, after 1,000 units had been given daily for four days, the cerebrospinal fluid contained twenty-four hours after the last dose about $\frac{1}{100}$ unit of antitoxin. Then 4,000 units were given intraspinally, and four days later the cerebrospinal fluid contained $\frac{1}{2}$ unit. The total amount of antitoxin given did not seem to have any influence on the antitoxin content of the cerebrospinal fluid. Thus after 20,500 units had been given intraspinally in six days, there was, twenty-four hours after the last dose, only $\frac{1}{10}$ unit per cubic centimetre of cerebrospinal fluid. One case was peculiar. There was

no history of antitoxin having been given (a prophylactic dose was doubtful), and yet before any serum was given in the hospital at Woolwich the cerebrospinal fluid contained about $\frac{1}{30}$ unit of antitoxin per cubic centimetre. This patient died. We cannot, then, as yet say what concentration of antitoxin in the cerebrospinal fluid it is necessary to attain in order that our efforts to cure may be successful.

The serum which was used in these cases was a refined and concentrated serum which contained sixteen per cent of protein and the protein content of the serum which is used for intraspinal injection may be of importance. For Henderson and Starling (1906) found that the rate of absorption of fluid from the eye was markedly slowed when serum was substituted for the normal aqueous humour and Weed (*loc. cit.*, p. 37) says that when the protein content becomes even slightly increased over the normal for a particular body-fluid the conditions of absorption are altered. Concentrated serum with a high protein content might be an advantage for intraspinal use, as not only could one inject a larger number of units in the same volume, but its stay in the sub-arachnoid space might be lengthened and its efficacy thereby increased. Besides Park and Nicoll (1914, *loc. cit.*) say, with reference to intraspinal injection, "a number of cases of 'dry tap' have been observed in the disease by those so expert in spinal puncture as to leave no room for doubt that the spinal canal was properly entered. In these cases three to five cubic centimetres should be injected." A highly concentrated serum would be a necessity in such circumstances if an adequate amount of antitoxin is to be given.

As regards the progress of the disease after serum treatment is begun, we must not expect it to cease at once.

Davies (1915) has noticed a tendency to slight improvement followed by exacerbation of the symptoms about the third or fourth day, and at one time felt disposed to attribute it to diminishing doses of serum; but further experience led him to the conclusion that it occurs without using smaller doses and may be quite a feature of the disease. Dreyfus and Unger (1914), who treated thirty-two cases of tetanus (ten deaths) with large doses of serum—in one case 152,000 U.S.A. units—state that in the cases which recovered they observed the same course of events. The tetanus usually progressed for a day or two, then came to a standstill and eventually proceeded to pass away gradually, with occasionally a recurrence. They also say that after these large doses of serum

it was noticed that there was almost always a rise of temperature, often to a high degree. Once there was diarrhœa and vomiting, which ceased when the serum was discontinued. With the serum they gave narcotics and $MgSO_4$. They tried phenol also in doses of 1·5 grammes *pro die*, but the disease continued to progress and there was no improvement until serum was also given. In Lister Scott's (1915) case the tetanus increased for a time, two to three days after treatment was begun, before it began to abate. The same course of events may be noted in Park and Nicoll's case quoted above.

We must therefore not lose faith in the value of antitoxin if the condition of the patient does not at once improve. Nor must we discontinue the serum if the tetanus quickly diminishes.

The following case, which occurred in a horse, is of interest in this connection. It will be noticed that, contrary to the usual routine, pure toxin alone was used from the commencement of the immunization. This case does not come into the same category as those mentioned by Davies, for in his cases there was continued production of toxin, whereas in this case the injection of toxin ceased on a certain specified date. Of course, it is just possible that a natural infection may have been super-imposed on the immunization, but our search did not reveal any port of entry.

Horse "K."

Date	Dose given intramuscularly	Minimal lethal dose for mouse	Minimal lethal dose for guinea-pig
June 13, 1911	—	$\frac{1}{20000}$ c.c.	—
,, 14, 1911	—	—	$\frac{1}{2000}$ c.c.
,, 21, 1911	—	—	$\frac{1}{3000}$ c.c.
,, 26, 1911	$\frac{1}{1000}$ c.c.	$\frac{1}{10000}$ c.c.	$\frac{1}{3000}$ c.c.
July 6, 1911	$\frac{1}{500}$ c.c.	$\frac{1}{12500}$ c.c.	$\frac{1}{3000}$ c.c.
,, 17, 1911	$\frac{1}{250}$ c.c.	$\frac{1}{10000}$ c.c.	$\frac{1}{3000}$ c.c.
,, 28, 1911	$\frac{1}{100}$ c.c.	$\frac{1}{11000}$ c.c.	$\frac{1}{3000}$ c.c.
August 8, 1911	$\frac{1}{50}$ c.c.	—	—
,, 18, 1911	$\frac{1}{25}$ c.c.	—	—

August 23, 1911.—Horse does not seem quite normal. Brought in from the field and put in loose box. 5 p.m.: commencing tetanus. 1,000 U.S.A. units of tetanus antitoxin given intramuscularly.

August 24, 1911.—Slightly worse. One ounce of pot. brom. given by mouth. 25,000 units i.m. 11.30 a.m. 2 p.m.: breathing very quick; eating well. 6.30 p.m.: breathing normal.

August 25, 1911.—Improving; eating well. Feeds at 6.30 a.m., 12 noon, 5.30 p.m., 11.30 p.m.

August 26, 1911.—Still showing signs of improvement; feeding well. 12 midnight: seems comfortable and quiet, standing in the loose box.

August 27, 1911.—2.45 a.m.: relapse. 25,000 units i.m. 6 a.m.: worse. 9.30 a.m. very much worse. Shot.

As only 231 guinea-pig minimal lethal doses had been injected and we had given sufficient antitoxin to neutralize 25,000,000 minimal lethal doses, and as the attack seemed to be passing off, we discontinued the administration of antitoxin. Result—a relapse and death.

Serum treatment should be continued until the patient is certainly out of danger.

Second Attacks.—An attack of tetanus does not confer any lasting immunity, and the possibility of a second attack must not be forgotten.

Happel (1915) records a most instructive case. A soldier was wounded at 6 p.m. on January 1, 1915, in the left thigh by shrapnel. A field dressing was put on at once and the wound was dressed again the same evening, and during the night he was transported to hospital. The wound was in the middle of the thigh and there was a comminuted fracture of the bones. January 4: Gas escaped from wound. January 6: Rise of temperature; ten cubic centimetres of antitetanic serum. January 7: Arrived at base hospital. January 23: Tetanus begun. Then, in the course of eight days, 1,120 A.E. (44,800 U.S.A. units) were given intraspinally. Also daily 0·1 to 0·18 grammes morphine. The profusely suppurating wound was appropriately treated. February 8: All tetanic symptoms gone. March 27: Put into an ambulance train, and on March 30 reached Biebrich Hospital. At this time he seemed in good health. There was shortening of the leg and a long scar on the outer side of the thigh. The wound had healed all but a small spot in the centre. After a time he was able to get up and attempt to walk. April 18: Noted as ready for discharge in a few days. April 27: Some inflammatory redness starting from the tiny unhealed spot. May 1: Pain in the back. Could not open mouth properly. The tetanus increased in severity and ended fatally.

Premonitory and Early Symptoms.—No one will dispute the statement that in order to obtain the best results from any method of treatment it is necessary that such treatment should be begun at the earliest possible moment in an attack of disease. This axiom is peculiarly applicable to the case of the antitoxin treatment of tetanus, and therefore it is necessary for us to examine very carefully and with full detail whether there are any signs and symptoms which may be considered to be forerunners of the "locked jaw" and which are accepted as diagnostic of an attack. Such symptoms have been described by Evler (1910), and reference

has been made to them in a previous article; but the idea of "premonitory" symptoms does not appear to have "caught on" in this country, and so the writer feels constrained to return once more to the charge and to place before the reader some of the evidence which is in favour of the correctness of Evler's views.

Roaf and Sherrington (1906) describe symptoms of tetanus which appeared in a large fully grown baboon (*Cynocephalus anubis*) forty-eight hours after the inoculation of tetanus toxin into a branch of the facial nerve to the lower lip exposed at the back of the parotid gland. They say: "The animal became unable to open its mouth sufficiently widely to bite a small apple, although previous to the inoculation it had easily seized large apples between its teeth and eaten them with free biting. Slight opening of the mouth was still noted at times, especially after repeated apparent trials to do so. The 'locked jaw' seemed most marked on the animal's waking from sleep. The right half of the lower lip felt under palpation distinctly firmer than the left half. The right palpebral fissure was less open than the left. The head was somewhat drawn toward the right shoulder and the chin somewhat turned to the left. These palpebral and neck symptoms we have seen occur regularly both after facial and limb inoculation with the toxin, when the tetanus was incipient in the head region. It was also noted in this animal that the line of junction between the two lower central incisor teeth lay sometimes distinctly deviated to the left. On palpation of the masseter muscle distinct fine tremor was recognizable in the right masseter but not in the left. A fine tremor of this kind we have detected regularly in muscular regions affected by the rigidity of tetanus; we have noted it in the muscles of the limbs as well as in those of the head, and in the cat as well as in the monkey. It has been of help in early recognizing the onset of the tetanic condition." In answer to an inquiry as to whether he had ever noticed in his animals any symptoms such as those described by Evler (cf. MacConkey, *British Medical Journal*, October 10, 1914) Professor Sherrington has kindly informed me that he has not noticed any swelling or heat of the injured member, nor difficulty in micturition, nor delirium, nor trembling or deviation of the tongue. But as it sits the animal (monkey, baboon, orang-utan) stares at the floor of its cage with a *grave, anxious gaze.* Inoculations into a limb were made into the internal plantar nerve trunk at the ankle. In about five days after the injection there was some postural extension of the ankle of the inoculated limb. Then the knee would be kept less flexed than on the normal side,

and on passive movement offered more resistance to flexion than the unaffected limb. The next thing usually was postural extension of the homonymous forelimb at the elbow, with resistance to passive flexion at this joint. This was followed by jaw trouble, the first appearance of which was revealed by the mandible under passive opening (i.e., depression), offering sudden resistance on reaching a certain degree of depression. Up to this point the jaw would open passively readily enough to pressure by the finger, but beyond this point the resistance was marked. The muscle tremor mentioned above could be detected, and on auscultation with a stethoscope a rumbling sound could be heard. When the inoculation was made into the facial nerve the jaw symptoms appeared before the limb symptoms.

Permin (1913) states that in ascending tetanus following the injection of tetanus toxin into one or other extremity the stiffness of the extremity is at first only slight; in the early days passive movements can be made, though a slight resistance can be felt; later complete tonic contractions occur. In man the occurrence of local cramps is a well-known early symptom, not often noted, though, no doubt, if more careful examinations were made, it would be met with more frequently.

Jochmann (1914), referring to tetanus in man, asserts that the visage takes on a characteristic appearance. The brows are knit, the palpebral fissure narrowed, the eyes are fixed, staring straight ahead, the naso-labial fold is deepened, the nostrils are raised, and the mouth is drawn into a painful laugh. There may be profuse sweats, but the profuseness is not proportional to the intensity of the cramps.

These symptoms described by Jochmann are like those given by Sherrington, but they cannot exactly be called early symptoms, as they are mostly those of declared tetanus in man. A study of recorded cases shows that there are symptoms which are earlier than these. They and the cases in which they were noted are given below:—

Anders and Morgan (1905).—Case 42. Two days after the injury the patient showed signs of irritability with unreasoning outbursts of anger, accompanied by jerky spasmodic movements, with a tendency to throw the head backwards. There was also nystagmus.

Hale (1898).—Abrasion on bridge of nose January 12, 1898. Sought advice first on January 27, "complaining of an uncontrollable impulse to laugh and of a 'drawn' sensation of the left

side of the face since January 25. He had laughed quite against his will on the receipt of the news of the death of a relative. No limitation of the movements of the jaw could be made out, nor any objective symptom. The abrasion had healed." January 30: slight but distinct trismus, slight ptosis of left eye and inability to close the eyelids completely; some slight facial paralysis and a painful feeling of stiffness round the waist. No cramps nor stiffness of the neck were complained of. January 31: symptoms somewhat more marked, some difficulty in swallowing, slight wrinkling of the forehead, a few cramps in the legs. Towards evening the neck became stiff.

Montais (1915) cites a case published by Broca (1915), in which extreme excitability or emotional disturbance was the first symptom. Later, twenty days after the wound, there was very slight trismus. Death took place five days later of asphyxia without there having been any general convulsive seizure.

Petersen (1910).—On the twelfth day after an abdominal operation the patient laughingly said she thought she was going to have mumps, as her face was sore at the angles of the jaw, and the latter seemed stiff. Examination showed no enlarged glands, no elevation of temperature. The condition remained much the same for eight days. Then the muscles of the back and neck became rigid, and there were sudden spasms of the muscles of the jaw. Patient became excitable. Temperature 100° F.

Caffrey (1910).—Ear-ache and pains in the chest.

Stromeyer (1910).—For some fourteen days pain in knees and back on walking. These disappeared when lying down. Then speech became not so clear and the expression of the face altered. The gait was spastic, but the legs were freely movable when sitting.

Burr (1908).—Case 1. No history of injury. Noticed on getting out of bed that the legs were stiff, and that he could only walk with difficulty. Tried to overcome the stiffness by walking but only made it worse. Got worse as the day passed. In afternoon epigastric pain and dyspnœa.

Chiari (1915).—September 8, 1914: Wound of left leg. Admitted September 14. During the following days left leg held stiffly. September 18: Distinct rigidity and pain on pressure of whole musculature of thigh.

German (1912).—Pains in the neck, stiffness in limbs and jaws. Thought to be influenza or muscular rheumatism as an examination did not disclose the cause of the jaw trouble. Patient *looked seriously ill*, though there was no cause to account for it.

Hauer (1912).—Felt weak, very tired feeling in legs. Some difficulty in swallowing. Later, mouth only half opened. Legs stiff; cannot sit down, but lies in bed.

Müller (1914).—Stiffness in wounded limb and a painful drawing and twitching in it. Tendency to sweating, constipation, dysuria and insomnia.

Paul Sainton (1914).—Dysphagia without local cause. Local contractures in wounded region.

Rogers (1905).—Case 7. Run over, wound of hand May 3. May 9: Complained first of some difficulty in swallowing—indicated by signs as he spoke no English. Nothing abnormal was apparent, and so the condition was not diagnosed until the next day, when there was severe tetanus.

Ramsay and Stoney (1915).—Bullet through both legs. On seventh day after wound complained bitterly of sharp lancinating pain in right leg when the dressings were done. Right ankle held very rigidly. Eighth day: Stiffness in jaws and difficulty in swallowing. The tongue on being projected deviated to the right and had a faint tremor.

Wiedemann (1910).—Case 1. Scrotal injury two to three weeks previously. For several days before being seen the left leg could not be used properly, and because of pain in the throat the mouth could not be opened fully. Case 2. Tear of thigh by nail. Wound began to pain at night so that left leg could not be moved.

Booth (1905).—Case 2. July 4: Wound of right palm. July 16: Very nervous and unsteady in walk.

Heilmayer (1910).—Eight days after injury difficulty in swallowing and slight redness of the tonsils. Taken to be catarrhal angina. Two days later trismus, etc.

Richter (1914).—No external wound. "Rheumatic" pains for ten days.

Barnsby and Mercier (1915).—Case 1. September 20: Wound left thigh. October 3: Painful and repeated cramps in lower limb. Case 2. September 27: Wound left thigh. October 6: Painful cramps in left foot. Photophobia. Case 6. October 21: Wound right arm. November 2: Painful contractures in neighbourhood of wound, later limited to wounded limb. November 4: Photophobia.

Goldscheider (1915).—Case 1. Four days' trouble in eating before trismus came on. Case 3. Six days' twitching in wounded leg before trismus. Case 4. Local muscular twitching and then for two days difficulty in eating—next day trismus. There may be local symptoms for a day or two, and then the patient wakens

one morning with trismus without having had any difficulty in eating.

Czerny (1914, twenty-nine cases).—Case 4. August 26: Wound right arm. September 1: Slight twitching of right forearm. September 2: Same subjective phenomena; flexors right forearm in slight contraction. September 3: Contractures of flexors of forearm with clonic spasms which were painful. Case 7. August 25: Wound left knee. September 4: Slight closure of jaws, ? risus. Ill-defined case, suggests mumps. Case 23. August 25: Wound right thigh. September 8: Complained of stiffness of right leg and pain in region of wound. Speech altered; tonic contraction of right quadriceps, which occasionally increases for a short time.

Eunicke (1914).—Case 4. Wounded August 25. Later (? date), right hand operated on. On the day after the operation slight cramp-like pains in right hand, and two days later a gradually increasing stiffness of face when eating. He thought he had caught cold. Shortly afterwards stiffness in back of neck.

Other cases could be quoted, but these will suffice to show what symptoms have been recorded as the first indication of an attack of tetanus. Some of those who have had a number of cases under their care have gathered their impressions together into short descriptions of the conditions they have met with very early in the disease. These should be compared with the symptoms quoted above.

Stricker (1914) mentions altered mental condition, anxious expression, impatience, insomnia, prickling feeling in the face, pain in the wound though it appears to be doing well, anorexia, increased thirst.

Kreuter (1914, thirty-one cases) says there may be difficulty in swallowing, with a negative finding in the throat, and the condition may be mistaken for commencing angina. One of the first signs were local cramps in the injured extremity. Photophobia was noticed twice. The trismus *commenced as intermittent* cramps and went on to tonic spasm.

Hochhaus (1914, forty-six cases) states that "the first symptoms are often so trifling that to the patient himself they may seem quite harmless, and even to the surgeon may appear unimportant." The most frequent first symptom was a "drawn" feeling, a trivial pain in the face muscles; less frequent was pain or prickling in the throat (as in commencing sore throat) or an insignificant difficulty in swallowing, tightness of the chest and stiffness of the neck muscles.

These prodromata were usually so trivial that the patients did not think it worth while to mention them. Often the first sign was connected with the wounded limb—there was a feeling of tension, or may-be marked pain, followed by twitching or stiffness of the muscles.

Schneider (1915, twenty-two cases) describes the early symptoms as drawing, twitching, "rheumatic" pains and stiffness in the wounded extremity. Mastication easily fatigues. Pains round the mouth, severe sweating, short cramps in the chest muscles like "stitch in the side."

Grundmann (1915, twenty-five cases) observes that the patient may not say anything calling attention to the early symptoms, which comprise difficulty in deglutition, profuse sweats, starting at slight noises, bright lights or sudden draughts, vertigo, twitchings, stiffness and increased irritability of muscles when tapped.

Weintraud and Unger (1914) consider it "imperative to recognize the first symptoms, which the patient only too often, in his touching patience, regards as too trivial to mention." They may include dizziness, heavy sweats, slight difficulty in urination, a feeling of tightness in the muscles of the jaws or of the back of the neck, or brief spasms of the muscles of the chest or of the diaphragm. The latter are liable to be mistaken for pleurisy pains.

Blumenthal (1914) is of opinion that pains and twitchings in the muscles around a wound liable to have been infected with tetanus germs should give the alarm at once and call for the injection of antitoxin. The slight pains are usually ascribed to rheumatism.

Heile (1915, twelve cases; five died, seven recovered) says there may be local cramps, a feeling of discomfort, of drawing or twitching in the extremities, very profuse sweats of the whole body or only of parts, slight difficulty in swallowing, often difficulty in sitting up from the recumbent position. He emphasizes the behaviour of the reflexes in tetanus. An increase in patellar or foot reflexes is an indication of increasing intoxication.

Bacri (1915) thinks that there exists after the incubation period, at the very commencement of the period of invasion, a period of treacherous calm. He lays stress upon: (1) Diminution in the extent of opening the mouth. (2) Painful contractions produced by slight active increase in the extent of opening. (3) Distinct and considerable exaggeration of the patellar reflexes.

There can be no doubt, then, that after injuries certain signs and symptoms may be present, and that these signs and symptoms are

frequently followed by an attack of tetanus. But whether they are true prodromata or not one cannot yet say definitely, as attention has not been directed to their presence or absence in cases which do not develop tetanus. This is another point upon which a collective study of the disease would throw light.

Then there are also those cases of tonic contractions and convulsive spasms which some regard as cases of tetanus but which others consider due to functional disturbance of the nervous system. Several such cases are on record :—

Stoney (1915) reports : M., aged 21, was wounded in right gluteal region on March 23. He appeared to be doing well and was allowed up. On April 6 he complained of being tired as he had walked too much, and on April 7 there was pain with spasmodic twitchings of the muscles of the right leg and tonic spasm of the whole limb, which was kept extended. Any attempt to flex the hip or knee was strongly resisted on account of pain, and any attempt at examination or movement increased the spasms. Under an anæsthetic both clonic and tonic spasms ceased. As the effect of the anæsthetic wore off the *clonic* spasms showed some tendency to return, but not the tonic. Later, both clonic and tonic spasms recurred. There was no rise of temperature or increase in pulse-rate. There was absence of contraction of the muscles of the jaw, neck and abdomen. Morphia, opium, bromides and aspirin in large doses had no effect in relieving the spasms.

This case was thought not to be tetanus.

Pozzi (1915) relates very similar symptoms as following a wound and fracture of the left tarsus. Neither morphine nor bromide, nor pantopon, nor chloral in large doses relieved the spasms. There was a rise in temperature which fell after the foot had been amputated. Antitetanic serum appeared to have little effect. It was not till about the twenty-first day of the disease that a definite diagnosis of local tetanus was made.

Rudolf (1915) had a case of this kind and thought it was not tetanus, while Courtellement (1915), in similar circumstances, considered that he had a case of tetanus to deal with.

Montais (1915) says he had several such cases of local tetanus under his care, and that tachycardia is most usual. The temperature is quite independent of the tetanus and is usually due to infection by other organisms. He discusses the differential diagnosis between this tetanus and meningitis, Jacksonian epilepsy and hysteria.

When after having been wounded, say in a leg, a patient

complains of pain in the wounded limb and on examination it is found that some of the muscles of the limb are in a state of tonic contraction (these tonic contractions may occur without the knowledge of the patient), and when painful clonic spasms are super-imposed upon the tonic and they tend to spread to and involve other parts of the body, one would be inclined to have no doubt that one had a case of tetanus before one. It is obvious, however, from what has gone before, that the question is not so simple and that there are diffeıences of opinion as to the correct diagnosis. Thus we have one more question which might be answered by a collective study of the disease.

Conclusions.

There is no doubt that the best use that can be made of tetanus antitoxin is to give it prophylactically; then it is reliable and, as the dose is small, economical. When used curatively the amount given must be very much larger, and even then one cannot foresee the result with any certainty as with the same dose of antitoxin, given under apparently exactly similar conditions, the result may be in one case recovery, and in another case death.

The treatment of tetanus is indeed a complicated question, the answer to which can only come from a joint effort. If all those who have wounded soldiers under their care will combine to study the disease, and each give their help towards deciding upon the value of: (1) the various premonitory symptoms; (2) the intra-spinal method of administration, and (3) large doses of antitoxin, it is quite possible that we may make good progress in the direction of solving the problem of the successful treatment of tetanus.

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PLATES FOR MASKING FACIAL WOUNDS.

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AND

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Royal Army Medical Corps (Territorial).

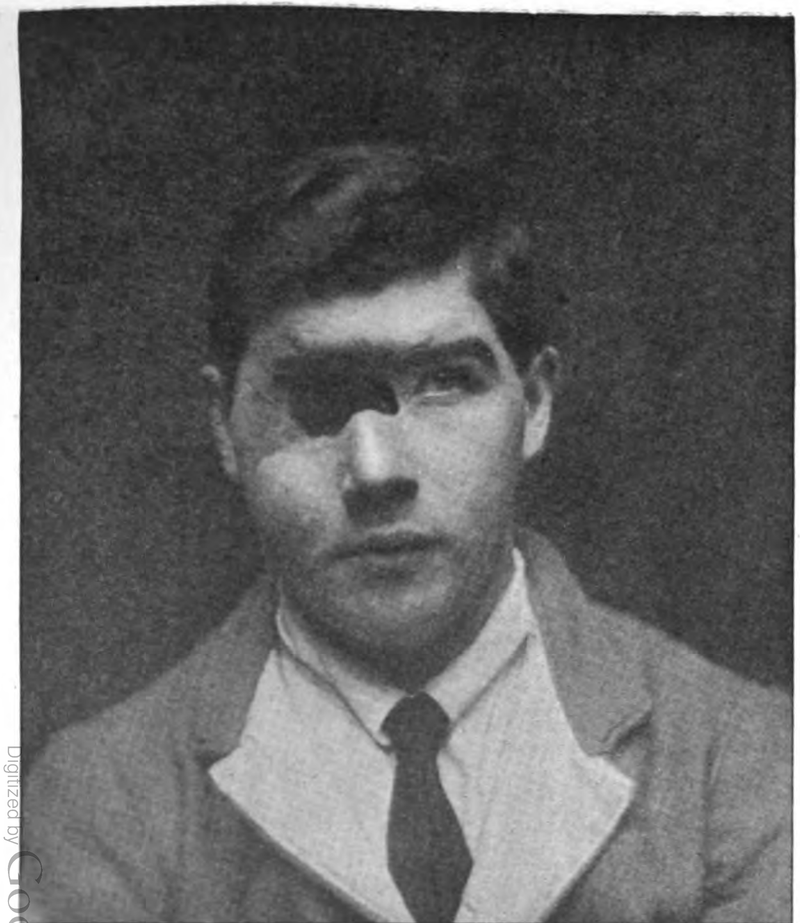
Driver F., Canadian Field Artillery, was admitted to the 3rd London General Hospital on May 28, 1915, after being wounded at Ypres, April 25, 1915, by a piece of shell which carried away the right eye and surrounding structures. The wound extends from a quarter inch internal to the inner canthus of the left eye to the right malar region, exposing upper parts of both nasal cavities. Above, the eyebrows are in great part still in position.

Externally the greater part of the malar bone, and inferiorly both nasal bones and nasal process of right superior maxilla, have been destroyed, the roof of the antrum being depressed to the level of the inferior turbinate, and there are two small openings into the antrum. The site of the orbit is covered with mucous membrane, which is united by healthy scar tissue to the surrounding skin; no operative treatment has been necessary.

On September 2, 1915, Trooper E. was admitted to the 3rd London General Hospital suffering from the results of gunshot wounds of the left arm and face, received on May 13, 1915.

The nose has been carried away, but while the right nares was covered in by skin except for a small but sufficient opening below, on the left was a chasm extending the full height of the nasal cavity, and exposing the turbinates to view. From the lower part of the left nasal outline, a deep fissured scar extended across the left cheek almost to the ear. In the centre of this was a sinus, discharging foul pus and leading to the left antrum. Bare bone could be felt in it. The left lower eyelid was detached from the cheek at the inner canthus for about half an inch and pulled downward, producing epiphora.

On September 29 I scraped the sinus in the cheek and removed some necrosed bone, at the same time making the opening in the left antral wall communicate with the mouth. Through this opening the left antrum was washed out daily until all discharge



Driver F.

had ceased. After this treatment the sinus in the cheek rapidly healed.

On October 8, under local anæthesia, Captain Cruise freed the left lower eyelid, raised it upward, and stitched it to the cheek by three sutures. The wound healed by first intention, and the patient was then able to close his eye properly.

On October 27 I performed a plastic operation to close the large opening into the left nares. The free edge to the left of the opening was split and its internal layer carried across the gap and united to the mucous membrane of the septum by catgut sutures. The irregular scar across the left side of the face was excised and the skin of the left cheek above this freed from the deeper sutures, and carried upward and forward to be sutured to the skin of the nose in the middle line. In this way the large opening into the left nares was closed by a double layer of skin and mucous membrane. The wound healed by first intention.

The condition of the patient after this operation is seen in the photograph. As there was no loose skin it seemed useless to attempt further to improve the appearance of the nose by operation; moreover, the artificial noses made by instrument makers are usually very unsightly. Fortunately, however, we have at the 3rd London General Hospital Serjeant Derwent Wood, the well-known sculptor, who has modelled for Trooper E. a facial mask which has enabled the patient to return to his former occupation as driver of a taxi-cab.

Process.

(1) *Casting Patient's Face.*—It is essential that a good fit on the edges of the plate should be secured; to this end a plaster mould of the face is obtained.

In the case of Driver F., and in consideration of the nature of his wound, I filled the cavity with his usual dressing, cotton-wool, covering this and his left eye and eyebrow with gold-beater's skin, bandaging all portions of his head that were not wanted in the mould; his nostrils were blocked with cotton-wool, the patient during the casting breathing through his mouth, and being seated with head thrown back and pillowed on a box. After the exposed portion of face has been oiled, the plaster is mixed with tepid water and applied. In five minutes the mould is removed, bandages stripped and the patient cleaned up.

(2) *Modelling.*—The mould having been obtained, it is dried, French chalked, and a clay or plasticine squeeze is obtained from

TROOPER E.

the mould, giving a positive model of the patient's dressed wound and the surrounding healthy tissues; this is fixed to a board on a modelling stand and a sitting from the patient with undressed wound is obtained. Modelling now commences, and such art as the sculptor may possess is brought to the test. A reconstruction of the wound in every detail is established, taking care that the depths and widths of the wound are accurately measured and modelled. The sculptor having completed his model, he proceeds to cast it, and procures the plaster positive of the wound and its surrounding structures. Another sitting is obtained, and the portions which are to be hidden eventually by the metal plate are modelled in clay or wax, the edges being blended to the uninjured portions of face, thus effectively masking any trace of wounds. This is once more moulded in plaster, and the edge of proposed plate being marked on the negative, a cast is obtained, edges are trimmed to marking and the model is ready to have the artificial eye fitted to the lids; this is done from the back of the model. The plaster eyeball is dug out, the requisite thickness of lids is carefully worked down, the glass eye placed in position and the edges of the lids made good with thin plaster.

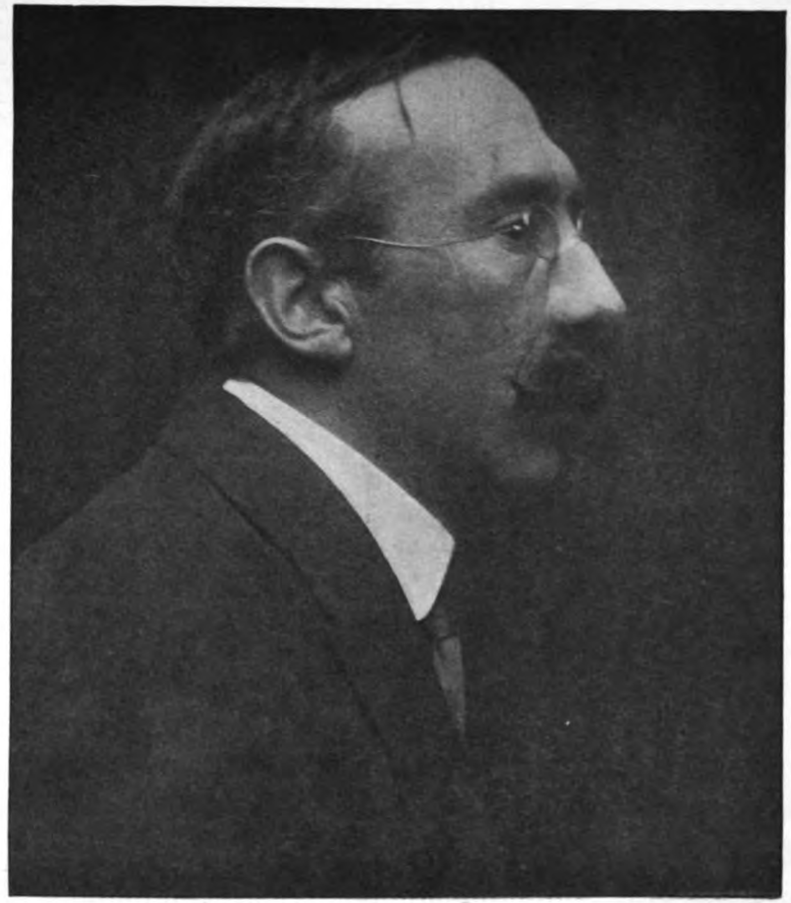
(3) *The Plate.*—The model is now taken to the electrotyper, where an exact reproduction by galvano-plastic deposit is made in virgin copper $\frac{1}{32}$ inch in thickness. This is finally well coated with silver. Thin bands are soldered in on the back to clamp the eye in place. The plate is again fitted to patient, strong spectacles are adjusted at the requisite angle to give a well-distributed pull on the plate. In the case of a large plate being used, an elastic band around the back of head is necessary.

The final sittings are devoted to the pigmentation of the plate. I have found a thin coating of cream-coloured bath enamel a good preparation for flesh colour matching, as it leaves the oil colour mat when dry, which is essential to the illusion of a good blending of plate with face; should the patient have shiny skin, this is easily obtained by varnish rubbed down to match the skin.

I have tried false hair on eyelids and eyebrows—they will not stand the weather—and have adopted tinfoil split with scissors and soldered into lids for the eye and for the eyebrows pigment applied to the modelled forms.

The two cases figured in this issue being the first handed over to me by the Commanding Officer (Lieut.-Colonel Bruce Porter), they were necessarily of an experimental nature.

A good deal of time was spent in their making; henceforth a month would cover the completion of similar appliances.



TROOPER E.

FIELD SANITATION.

By Captain E. BROOKE PIKE.
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It has been suggested that the following notes made in the course of the writer's duties in Flanders as Officer Commanding a Divisional Sanitary Section may prove of interest to readers of the Journal.

The problems which meet the sanitary officer in the field are so many-sided, and present themselves in such haphazard and inconsequent fashion, that some natural misgivings arise in the mind of the writer concerning his ability to so arrange his notes that they may present a lucid sequence to the mind of the reader.

In the Division it was decided to form an exhibition of sanitary appliances for use in the field, which could be inspected by officers and sanitary squads of the various units. This was done with the object of creating throughout the Division a uniform system of sanitation suitable to the peculiar conditions of the country, and to provide a practical guide to those responsible for the sanitary upkeep of their camps, and to those whose duty it was actually to construct and work the necessary apparatus.

The exhibition was composed of practical working models, particular care being taken that only such rough-and-ready materials were used as could be easily obtained by the units themselves. The constructional work was done by the Divisional Sanitary Section in a field adjacent to their headquarters,

The models and methods described are the outcome of the frequent intercourse of those whose whole efforts are directed towards the improvement of sanitation at the Front and the conditions under which the soldier lives. The happy result of this intercourse, in which ideas are freely exchanged, is apparent in the health statistics of the Expeditionary Force, the sanitary conditions of the camps, and in the many ingenious forms of apparatus which have been devised to cope with the difficulties encountered.

Latrines.

In considering the question of sanitation and the disposal of excreta, two main factors had to be borne in mind: (1) The circumscribed areas occupied during a long period of time by large bodies of men; (2) the almost impermeable character of the

Flanders soil and the consequent difficulty in disposing of urine by earth absorption.

In view of the fact that so much ground had been fouled by troops in occupation of this country since October, 1914, and its indefinite continuance, it became evident soon after the arrival of the Division that the trench system of latrines must give place to the pail system in order to conserve the ground as much as possible, and keep it generally unpolluted.

The various forms of pail or its substitute are illustrated below:—

(*a*) *Regulation Latrine Pail.*—A stout galvanized iron bucket shaped like a coal-scuttle with a swinging handle over the centre and a fixed handle half-way up the front and the back.

(*b*) *Cresol or Paraffin Drums.*—These, with the lids removed, form strong and serviceable latrine buckets. They should be sunk into the ground nearly to the top rim. Their drawback is that the diameter of the drum is rather small and the sides are therefore apt to be fouled. This difficulty may be overcome by cutting the opening in its length and removing about one-third of its circumference instead of removing the lid. The drum may then be sunk into the ground nearly level with its cut edges.

It is convenient, in this case, to make a hole in the bottom end directly opposite the bung hole, so that a stick may be passed through to facilitate transport to the dump or the incinerator.

(*c*) *Chloride of Lime Tins.*—These make good latrine buckets, and should be fitted with a wire handle sufficiently large to fall easily over the side of the tin to prevent fouling when in use.

(*d*) *Biscuit Tins.*—These are not altogether satisfactory in use. A large percentage of the tins leak badly, and they are so frail that they very quickly get out of shape and become useless unless some support is given. But they are the form of tin most easily obtainable, and serve the purpose until stronger tins can be collected; but they should always be strengthened by fixing a wooden fillet round the top. They should also be provided with a wire handle.

(*e*) (1) *The Combined Latrine.*—This is formed of two chloride of lime tins. The lid of one is entirely removed, the lid of the other is cut away to within three inches of the fourth side, to form a flap. This flap is then bent over the edge of the first tin, to hold the two together and to prevent fouling between them. If a man squats over this combined latrine correctly, the fæces are caught in the back tin and the urine in the front. To insure a correct position it is necessary to place bricks or pieces of wood to indicate

the position of the feet. It is further necessary to explain to the men the purpose of the double tin and the foot bricks, or they may face the other way round and defæcate into the wrong tin.

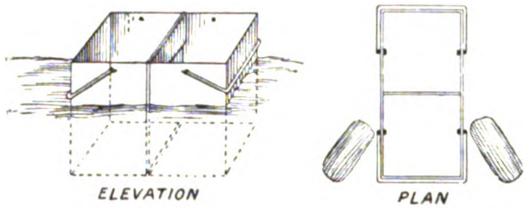

Fig. 1.—Combined latrine.

The advantages of keeping the solids separate are obvious; much less earth is required to cover them, the covering earth remains dry and not urine-soaked, the dumping pit lasts longer, and less ground is fouled in consequence. But the drawbacks mentioned do undoubtedly militate against the success of the system, unless the latrine be very efficiently policed.

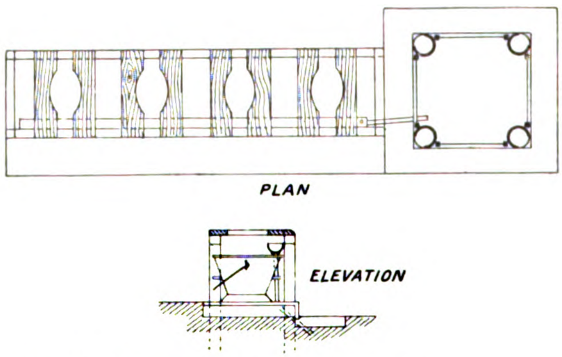

Fig. 2.—Lieutenant-Colonel Sharpe's latrine.

(*e*) (2) A much better means of attaining the object has lately been devised by Lieutenant-Colonel Sharpe and a model completed. It consists of a pole for a seat (proper seats would be much better) supported on trestles. Attached to the pole, and conveniently placed facing the men sitting down, is a galvanized iron trough bent in the manner shown in the sketch, and having a slight fall towards one end. The fæces fall into a single bucket and the urine is caught in the trough and carried away direct to a urine pit.

The fæces are thus kept dry and their subsequent disposal, either by burial or incineration, greatly facilitated.

(*e*) (3) Another plan is to perforate the latrine tins with small holes a few inches from the bottom and sink them in a trench of broken brick, having a slight fall towards a urine pit. The liquid runs off through the perforations, and the solids remain for burial or incineration.

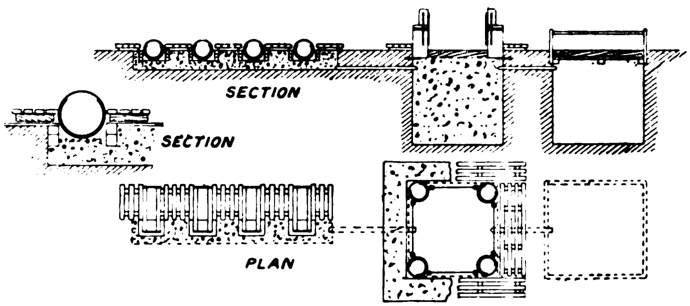

FIG. 3.

(*e*) (4) The most complete system of the kind is that devised by Surgeon-General Macpherson and modified by Lieutenant-Colonel L. Way. It has been successfully employed for many months. The whole process, from defæcation to incineration, is carried out in the latrine itself, the man immediately disposing of his own fæces (fig. 4).

The apparatus consists of a petrol or chloride of lime tin cut vertically in half. The end of one half is bent back to form a support, giving the tin a backward slope when laid on its side. The end of the other half is partly cut away, and this half tin rests upon and projects over the first with a slope forward as illustrated in the sketch. The whole rests upon a stand which keeps it in position. The seat is so arranged that the urine is caught in the front tin and the fæces in the back. In use, a man takes a piece of newspaper—cut to convenient size and kept hanging in the latrine—and places it in the back tin, taking care that the paper projects well over the back edge. After defæcation he takes the two halves adrift, empties the urine into a tub and the fæces into an incinerator which is kept constantly burning in the latrine. The piece of newspaper generally prevents any fouling of the back tin.

The process sounds somewhat complicated and idealistic, but is said to work admirably. For a hospital, or for places where

close personal supervision and control can be exercised, the process is a very sound one.

(*f*) *The Earth Trench Latrine.*—In view of the circumscribed area at present occupied by the troops, and the possibility of its being so occupied for some time to come, it is obvious that, with the digging of such large numbers of earth latrines as would be required daily, the upper layers of soil over the whole area would quickly become fouled. It was, therefore, decided to adopt the bucket system of collection, with incineration of the contents or daily burial in a pit some distance from camp.

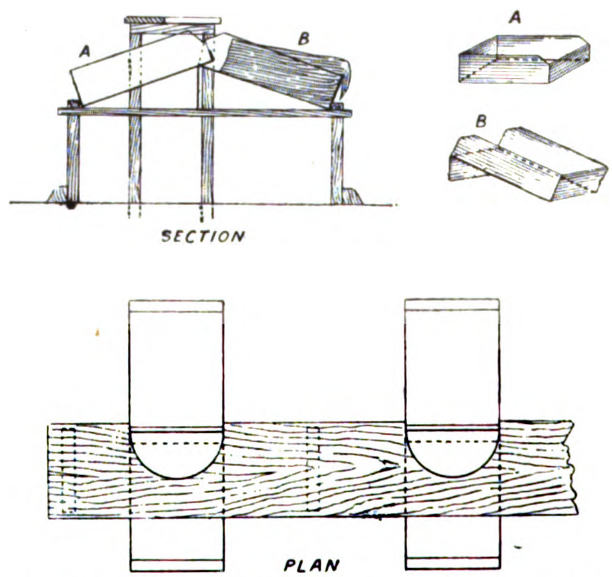

Fig. 4.—Surgeon-General W. G. McPherson's method of combined latrines for individual incineration as modified by Lieutenant-Colonel L. Way, with wooden supports and seats.

Circumstances, however, sometimes necessitate the use of earth latrines. In such cases, short, narrow and deep trenches are dug, two feet long, one spade wide, and as deep as possible.

The question of the provision of seats in latrines is a very debateable one. The long pole has serious drawbacks from a sanitary point of view, and has been generally condemned. But proper wooden seats have many advantages, provided great care is taken to ensure their cleanliness by constant supervision and the

daily scrubbing down with soap and water, to which a little 3 per cent cresol solution has been added. But in rainy weather, when the seats get wet, men avoid sitting down, with the result that the seats quickly become fouled and dirty. Of course, where it is possible to have the latrines under cover this objection disappears.

There are two forms of seats which greatly reduce the chance of fouling and the possible spread of disease. The first consists of a front half of a normal seat, the second of blocks of wood with grooves cut in the under-side to fit upon cresol or paraffin drums.

Disinfection of Urinals and Latrines.—Without doubt the best and simplest disinfectant and deodorant is a covering of earth each time the latrine is used. Its effect is entirely advantageous, and assists, instead of retarding (as do other disinfectants), the natural bacterial action, which results in the splitting up of the complex organic substances into their inoffensive elements, and their incorporation with the surrounding soil. It does not, however, keep out flies from the latrine, whereas cresol, if rightly used, does.

The disadvantages attending its use are:—

(1) The difficulty of maintaining a supply of dry soil when trench latrines are not being dug.

(2) The additional bulk, necessitating more frequent emptying.

(3) Where fæces are incinerated, earth reduces the combustibility.

(4) The fact remains that men will not regularly cover their excreta with earth, or do so incompletely. This forms an attraction for flies and a source of disease.

A tin of chloride of lime should be kept in the latrine, and the sanitary corporal should go round at regular intervals and throw some of the powder over the contents of each bucket. At the same time it is a good plan to set light to the paper, sprinkling first with a little paraffin; the bulk is thus greatly reduced and the buckets sterilized. Instead of the chloride of lime a sprinkling of cresol may be used. In urine tubs a tablespoonful of crude cresol is preferable to the chloride of lime.

Latrine buckets require cleaning daily—a duty invariably neglected. A useful method is to mop out the buckets immediately they are emptied with a three per cent solution of cresol (three tablespoonfuls to the gallon of water) and afterwards to smear the insides with crude paraffin.

A tablespoonful of crude cresol should be added to each bucket before use.

URINALS.

(*a*) *The Urine Soakage Pit.*—A hole is dug four feet square and four feet deep, and filled to within six inches of the top with broken brick or clinker; failing these, jam or bully beef tins, with holes punched in the bottom and sides, which have been passed through

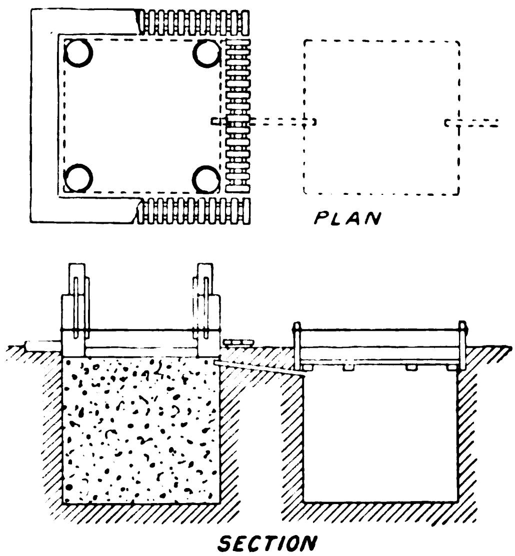

FIG. 5.—Urine soakage pit and overflow.

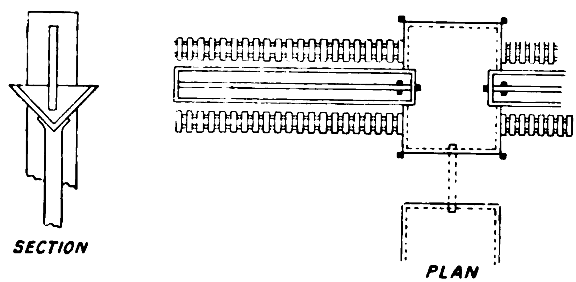

FIG. 5A.—Urine trough.

the incinerator, may be used. At each corner of the pit is placed a cresol or biscuit tin, perforated at the bottom, resting on the material with which the pit is filled. Earth is thrown lightly over the surface, which is roped round to prevent men from trampling it down.

It is sometimes convenient to arrange for a trough to drain into the pit instead of, or in addition to, the corner tins. In the trough illustrated space is saved, since both sides may be used at the same time.

Two such pits have been known to dispose of the urine of eleven hundred men for fifteen months without offence, and were still efficient. In this land of clay such results are not to be expected; but, even so, small units have had these pits in use since the middle of June, and they show no indication of filling up after four months' use.

It is quite a good plan to dig a pit near the incinerator, filling it with tins which have passed through the fire. The pit should be the receptacle for all the urine passed in the camp, both day and night urine tubs being emptied therein.

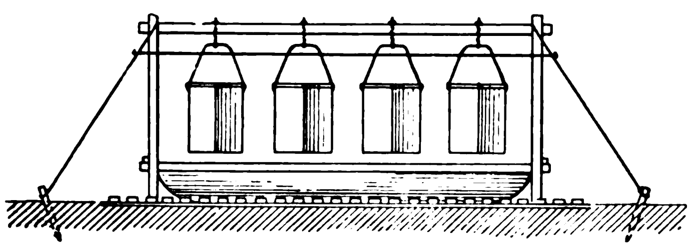

Fig. 6.—Urinal

(*b*) A convenient form of urinal is made by slinging chloride of lime tins on a pole supported at each end by trestles in the manner shown in the sketch. A tray holding cinders is placed beneath the tins to absorb the drops which fall to the ground. The tins swing freely and the contents can be tilted into a bucket and carried to the common urine pit.

(*c*) Night urinals in the form of cresol or other sound tins should be placed at frequent intervals near the men's tents or bivouacs. These should be painted white, to render them visible at night, and be raised to a top height of two feet three inches to prevent any fouling of the surrounding soil or banked with a semicircle of tins eighteen inches high. Trays containing sand or earth should be placed beneath them to protect the surrounding soil.

(*d*) A very convenient urinal for use in the trenches is sketched (fig. 8). It consists of a cresol drum let into the wall at a suitable

height, leaving only two or three inches projecting into the trench. Above the vessel a piece of tin is fastened. This prevents the wall being fouled.

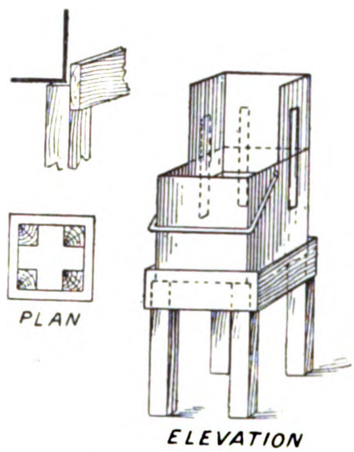

FIG. 7.—Night urinal

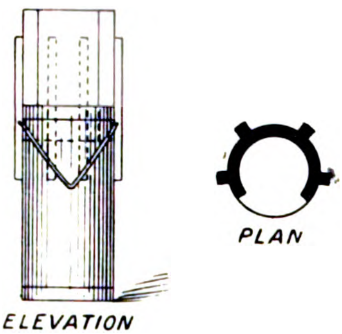

FIG. 7A.—Night urinal.

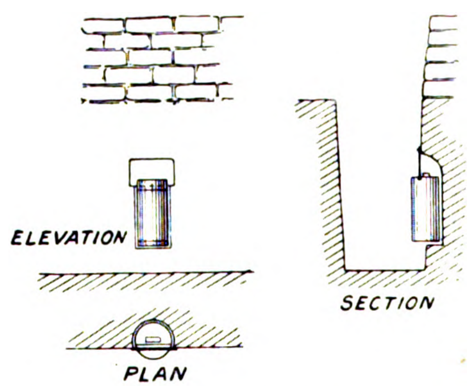

FIG. 8.—Trench urinals.

GREASE TRAPS.

Wherever cooking is done and whether the cookhouse be large or small, under cover or in the open, a proper grease trap should be built and all greasy water passed through it. If this precaution be neglected, the ground in the vicinity is bound to become badly fouled and an attraction for flies. Grease forms on the surface of

the soil a felt-like scum, which is a more or less permanent pollution and is very difficult to remove.

A very practical form of grease trap is in general use throughout the Division. It is not difficult to construct, and with a little attention is quite efficient.

A pit is dug three feet cube with a surface trench leading into it, nine inches wide, nine inches deep and five feet long. At the end farthest from the pit is placed a tin, containing hay, with an outlet at the bottom leading into the trench. Inside this tin is placed a smaller one perforated at the bottom and containing hay, tea leaves, or sawdust. The trench itself is lined with tin and filled with brick or coke broken down to walnut size.

The greasy water passes through the tins and along the trench, cooling and depositing the grease on the broken brick, whence the clear water flows into the soakage pit. Both pit and trench should be covered over to prevent the access of flies. Every alternate day the broken brick should be taken from the trench, burnt in the incinerator and replaced. If this precaution be neglected, the trench becomes choked with grease and the whole apparatus inoperative.

Another form of grease trap is constructed as follows:—

A wooden box is made four feet long, two feet wide and three feet deep. A partition is fixed eight inches from one end and reaching from the surface to within three inches of the bottom.

The whole box is then filled with material graduated from below upwards in the following way:—

Twelve inches broken brick (walnut size), six inches broken brick (pea size), three inches sand, covered with hay.

The water percolates down through the filter, beneath the partition and up the other side to the outlet, whence it runs into a soakage pit.

When the sand becomes greasy and clogged, as it does very quickly, the surface is scraped off and fresh sand added. The hay is burnt daily.

Incinerators.

Whenever possible incinerators are built of brick; failing this, and as turf is so seldom available, puddled clay is used. The most convenient method is to fill sandbags with the wet clay, the incinerator can then be quickly built in any shape or size desirable. The bags burn away, leaving the burnt clay baked hard. Draught holes should be arranged in the first row of sandbags, upon which

also should rest a grating of iron or stout wire firebars. A very common mistake in building incinerators is to make them of too large a diameter for the amount of refuse they have to dispose of.

For an infantry battalion six feet diameter and three feet six inches high is a suitable size. For smaller units a diameter of three feet is sufficient, the height still being three feet six inches.

The illustration shows an incinerator of this type, with the addition of a cone of corrugated iron wired to a tripod of iron bars fixed in the sandbags.

One piece of the corrugated iron is swung on wire hinges, forming a door through which the incinerator can be fed. This cone causes an extra draught and makes the incinerator burn like a furnace.

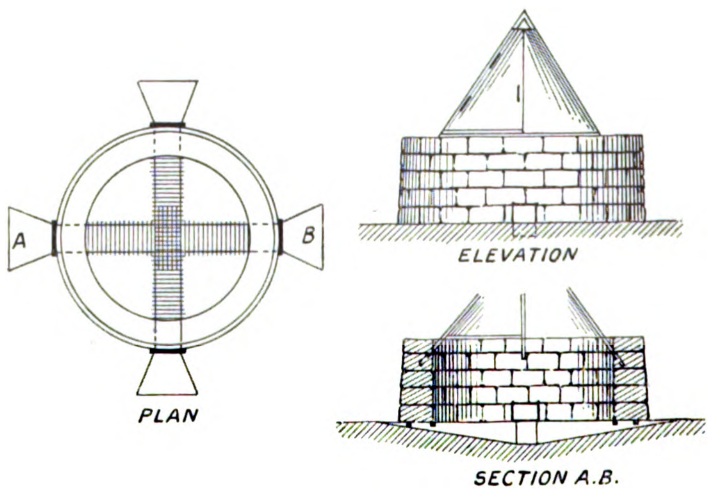

Fig. 9.—Incinerator.

Instead of sandbags, biscuit or chloride tins filled with clay are often used. Carefully built and vamped with clay on the outside these make an excellent substitute for bricks, particularly if the bottom of each tin is let into the top of the tin below, the weight keeps them in position.

Another form of incinerator is illustrated in fig. 10. Three walls of turf are supported and held in position by strands of wire fixed to posts at the four corners. The fourth side consists of a sheet of corrugated iron moving in a groove, which can be slid to one side when the incinerator requires clearing of burnt rubbish, ashes, etc. This feature is of considerable value in prolonging the life of an

incinerator, since most of the damage is caused by men leaning over to dig out the contents and damaging the walls in the process.

Should there be no materials or convenience for building an incinerator, quite a feasible plan is to dig one in the ground. Plans of two different types are given, both of which have proved efficient in practice.

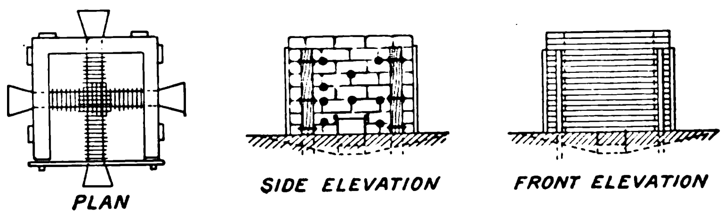

Fig. 10.—Turf incinerator with corrugated iron front.

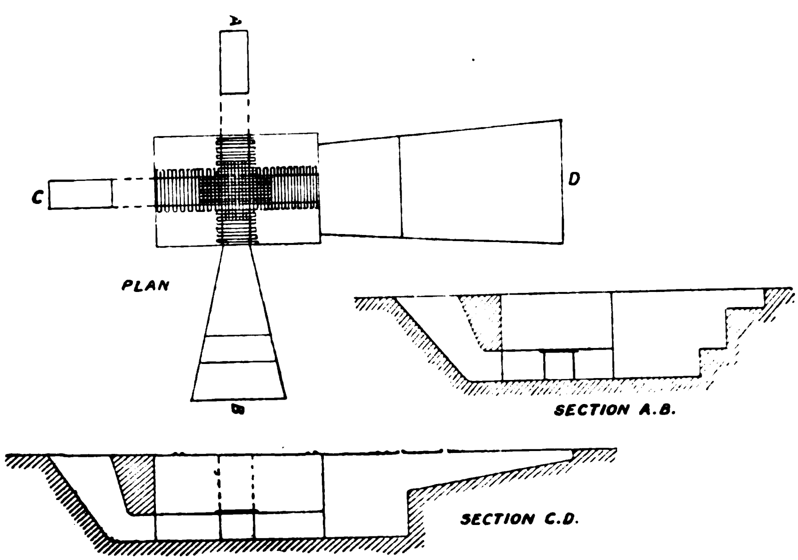

Fig. 11.—Underground incinerator.

When bricks—preferably fire-bricks—are obtainable, it is easy to build a permanent incinerator capable of burning fæces as well as ordinary camp refuse—it being premised that the liquid is separated from the solids before attempting to burn the latter. This is done by emptying the contents of the latrine pails on to a sloping platform of concrete draining into a soak pit.

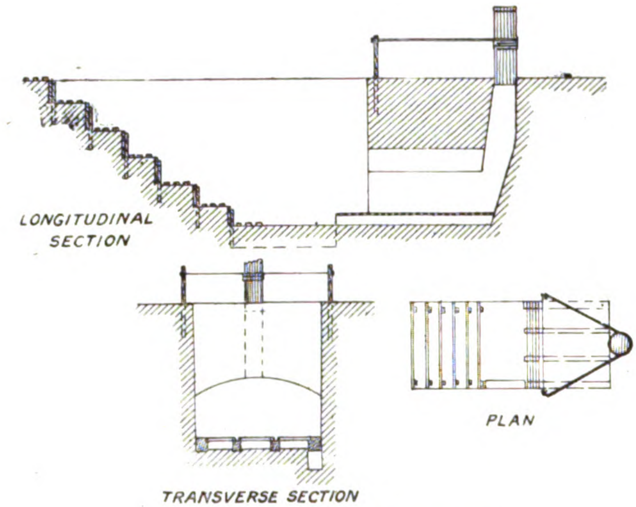

FIG. 12.—Underground incinerator.

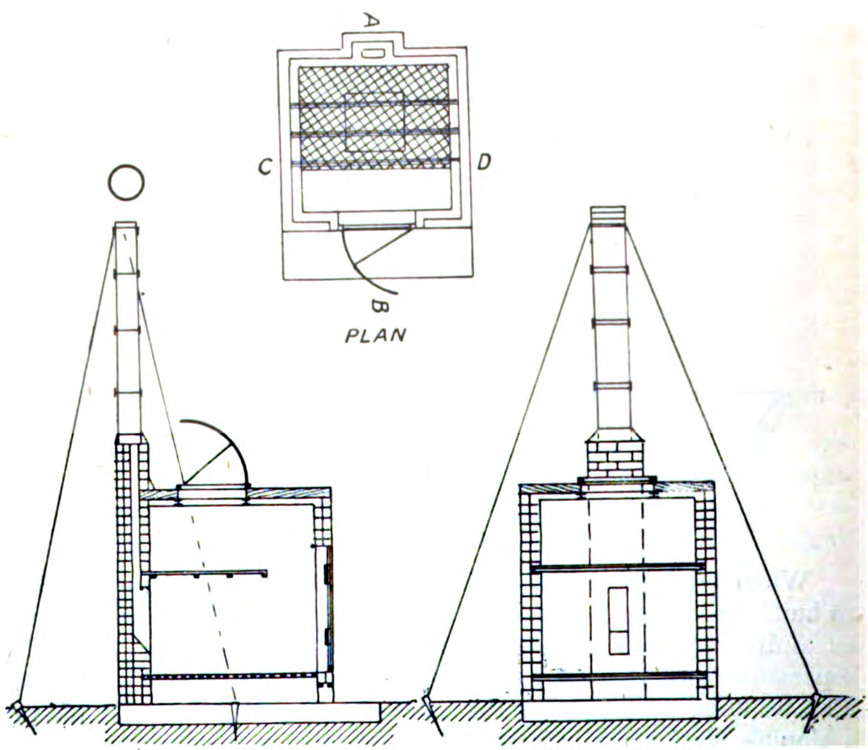

FIG. 13.—Destructor (fæces).

The illustration shows the construction of such an apparatus, which contains two grids—the upper one intended for drying the material before raking it into the fire on the lower grid. The incinerator is fed through a sheet-iron door opposite the upper grid, a smaller door for stoking and removing ashes, etc., being fitted on a level with the lower grid. The flue is carried down below the level of the fire, so that all the products of combustion must pass through and be destroyed, thus preventing any offence. It should have an opening in the back wall well above the grid level for clearing the flues.

Two adjuncts to every incinerator must be mentioned :—

(*a*) The refuse dump.

(*b*) The refuse pit.

(*a*) It often happens that an incinerator becomes choked up and the fire put out through the indiscriminate addition of fresh rubbish to that already burning. It is therefore useful to provide an enclosed space close by into which the camp refuse can be thrown as it arrives. This allows the fire to be fed and kept burning to the best advantage, and serves to prevent pieces of paper, &c., flying about the camp and making the place untidy.

The refuse dump can be made of turf, clay, wood, or wire netting.

(*b*) The refuse pit is dug of any convenient size, and receives the burnt contents of the incinerator. It is sometimes economical and convenient to use such a pit when full as a urine pit. In winter time burnt tins should not be buried. Rolled flat, they serve as an excellent foundation for paths.

Ablution: Disposal of Soapy Water.

Many types of ablution bench are in use. In one a wooden horse trough, with a plug at one end, is filled with water in which several men wash together. An improvement on this type is provided with wooden partitions in the trough, about one foot apart, with a plug hole in each compartment and a small trough underneath to carry off the soapy water.

The provision of washing apparatus is a comparatively simple matter, but the disposal of soapy water—or indeed of any liquid impurity—is one of the most difficult problems facing the sanitary officer in this land of clay. A soakaway pit for such a large volume of water is impracticable. Soapy water must find its way back to the pond it was drawn from or to another pond, or it must drain

into a ditch. In order, therefore, to foul these water sources as little as possible, all the scum must be removed, and as much of the soap as can be extracted, by filtration.

Many methods have been tried to effect this object. In that illustrated (fig. 14) the water passes from the ablution bench through a biscuit tin containing hay, into a pit filled with broken brick. From the bottom it rises through a second pit also filled with broken brick, whence it flows through surface drains filled with rubble or cinder, either direct into a ditch or into a patch of

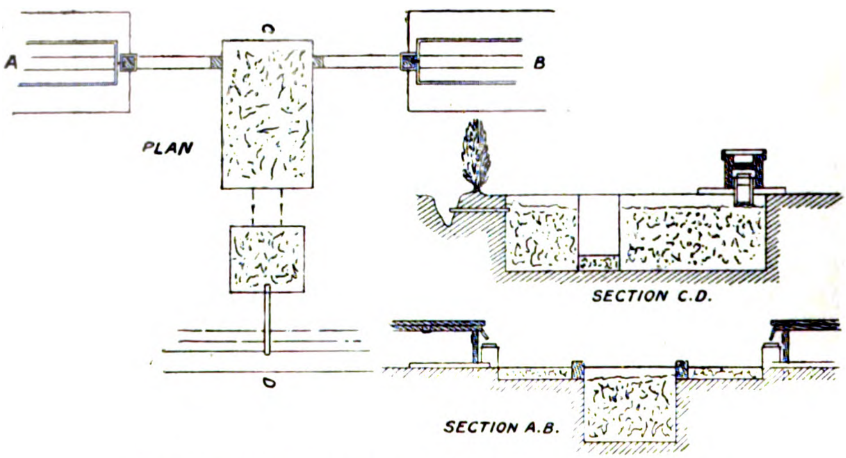

Fig. 14.—Ablution benches, etc., and disposal of waste water.

ground prepared by digging over the surface one foot deep. A second patch of ground is prepared for use when the first becomes waterlogged—the two being worked alternately.

A more elaborate soap trap and one which gives excellent results is illustrated in the sketch (fig. 15). It is suitable for standing camps.

It consists of a stout wooden box, 4 feet square and 2 feet 4 inches deep, which is divided vertically into six compartments—four filled with straw and two with coke—providing alternate downward and upward filtration. From the box the effluent discharges through a pipe into a boarded pit 5 feet square and 4 feet 9 inches deep, containing 3 inches of coke covered with 9 inches of sand. The floor of the pit slopes to a small central chamber 13½ inches square, formed of one layer of loose bricks covered with wood or tin. The water from the box falls on to a board resting on the

filter and is thus distributed over the surface without disturbing the sand. After passing through the filter it drains into the catch-pit, whence it flows through a discharge pipe into the ditch or pond.

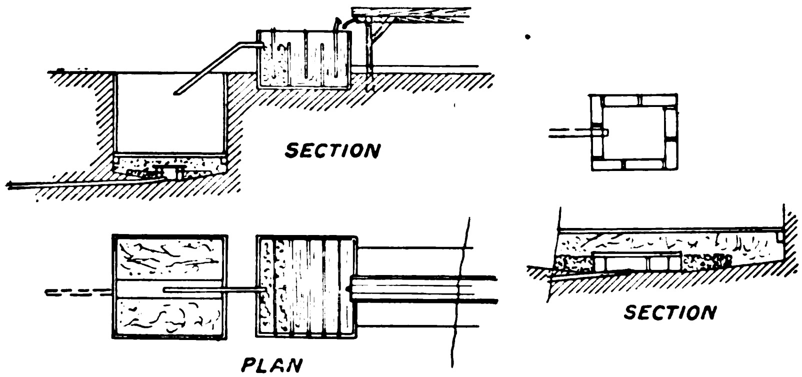

Fig. 15.—Soap trap.

The following sketch (fig. 16) illustrates a modification of the above design suitable for use in the field. Its practical advantages are that it can be dug in the ground; it requires a fall of only 2 feet 6 inches and it obviates the necessity for the somewhat cumbersome box.

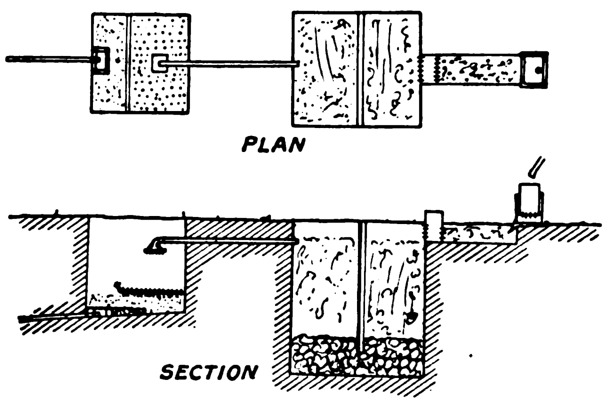

Fig. 16.—Soap trap.

The dirty water passes through a tin containing hay, into a trench 6 inches deep and 3 feet long, through a second tin of hay, the sides of which are perforated back and front, into a pit 3 feet

square and 4 feet deep. A wooden partition wall reaching from the surface to within 6 inches of the bottom divides the pit into two compartments connected at the base. The water passes down through 2 feet 3 inches of broken brick and 1 foot 3 inches of coarse rubble in the first, and up through 1 foot 3 inches of coarse rubble and 2 feet 3 inches of fine ashes in the second. It then passes into another pit through a pipe with a rose spray. This second pit is 2 feet 6 inches deep with a slight fall to the outlet pipe leading to the pond or ditch. The effluent falls in a spray on to a tray of perforated tin resting on a final filter-bed composed of 6 inches of sand over 3 inches of broken brick—the outlet pipe being protected by a small catchpit made of loose bricks covered with tin.

Latrines in the Trenches.

Small communication trenches are made leading from the main firing and support trenches, as indicated in the sketch. These are fitted up with latrine buckets and urinals. Tins for the men to urinate into (see Sketch No. 8) are let into the main trench walls.

Chloride of lime and cresol are used as disinfectants and deodorants and the latrine contents are buried at night in pits dug in rear of the trenches.

At the door of each dug-out is hung a sandbag for the reception of food scraps, etc., which are collected daily and buried with the fæces.

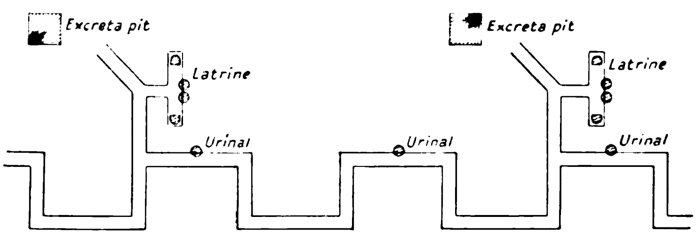

Fig. 17.—Trench latrine.

Horse Lines and the Disposal of Horse Manure.

Horses should be disposed as much as possible round the hedgerows or under trees for the purpose of concealment from aircraft. In order to avoid contamination of the ditches and ponds, which constitute the main source of horse water supply, it is necessary to arrange, where possible, for the horse standings to have a slight fall away from the hedge and towards the field.

Brick or concrete standings should be laid, and during winter time a covering should be provided of corrugated iron or tarpaulin supported by a skeleton framework of wood, which should be erected against a wall, or have a backing of wood or canvas, for protection against the weather. A cement drain should be provided to carry away the urine to a soak pit.

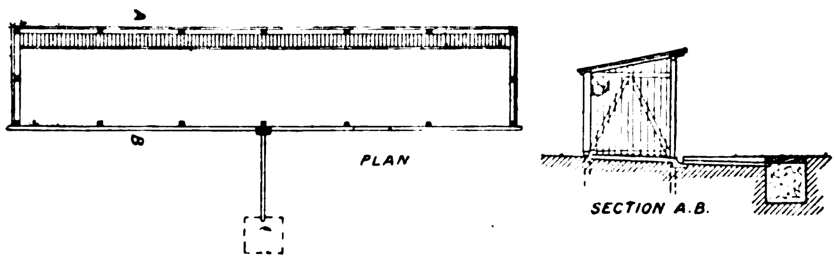

Fig. 18.—Horse lines.

The horse manure is disposed of in one of the three following ways :—

(*a*) Distribution on farm lands.

(*b*) Incineration.

(*c*) Depositing in heaps and covering with earth.

(*a*) The simplest and most economical method is distribution on farm lands. It is the custom for the farmer to provide the cart while the unit concerned supplies horses and labour. The manure is dumped on the field in separate cartloads and spread by the farmer.

(*b*) Incineration can be carried out in dry weather in small heaps on the ground; when once alight, these will smoulder away and become reduced to ashes. It is, however, rather a tedious and untidy process much affected by wet weather. A better plan is to burn the material in either a Horsfall Incinerator—a regulation apparatus consisting of an outer casing of iron, an inner lining of firebrick with a half-inch air space between, and fitted with a long chimney. A heat well over 500° F. is generated in such an apparatus, and with careful management it can deal with a large quantity of horse manure and dispose of human fæces and ordinary camp refuse at the same time. An open incinerator will dispose of horse manure fairly easily. It should be made of hit-and-miss brick-work (biscuit tins filled with earth make a good substitute for bricks), about three feet in diameter and from four to five feet high.

(*c*) This method may be resorted to when disposal by incineration is difficult and the land covered with growing crops.

The manure should be stacked four or five feet high and, in summer time at least, sprayed over with paraffin and the surface burnt or covered with earth at least one foot in depth, particular care being taken to protect the edge of the heap near the ground. Fresh manure is the most prolific source of the fly trouble, the warmth and moisture creating ideal conditions for hatching out the eggs. If the daily accumulation be immediately surface burnt or covered with earth the flies cannot breed there. The heap should be stacked systematically, the manure being added to one end of the line each day, and dealt with as described.

The illustrations accompanying these notes are from sketches made direct from the models by Acting Corporal N. Heather, R.A.M.C.(T.), of the 25th Sanitary Section.

THE BACTERIA OF GANGRENOUS WOUNDS.

By Major H. R. DEAN, M.D., F.R.C.P.

AND

Captain T. B. MOUAT, M.D., F.R.C.S.

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Third Northern General Hospital, Sheffield.

(*Report to the Medical Research Committee.*)

(*Continued from p.* 208.)

Case 16.—Sergeant H. B., aged 20, shrapnel wound of right leg. Wounded May 19. No antitetanic serum was administered.

Condition on Admission.—Patient presents shrapnel wound of the outer side of the leg just below the knee. Numerous incisions had been made about the wound, presumably for cellulitis, but the wound itself did not appear to have been opened up. May 25: Pieces of shrapnel and cloth removed from front of interosseous membrane, and wound drained. On May 26 signs of tetanus developed. Intrathecal and subcutaneous injections of antitetanic serum were given. The patient rapidly became worse and died on May 30.

Bacteriological Examination.—Films showed numerous pus cells and a few small Gram-positive cocci occurring in pairs and short chains. Anaerobic cultures only were made. Broth was freely inoculated, heated for half an hour at 80° C. and incubated for five days. The films then made showed numbers of *B. aerogenes capsulatus* but none of other varieties of bacteria. Glucose agar plates were inoculated and yielded a pure culture of *B. aerogenes capsulatus.* The original broth culture was returned to the anaerobic chamber for a second period of five days (ten days in all). Films were again prepared and on this occasion showed numerous tetanus bacilli as well as *B. aerogenes capsulatus.* Two guinea-pigs were immediately inoculated with one cubic centimetre each of the broth. One of these animals died three days, the other four days after inoculation. Well-marked spasms were observed in both animals. Glucose agar plates were inoculated from the ten-day-old broth. The plates were incubated for four days and produced numerous colonies of *B. tetani.* The plates also showed colonies of *B. aerogenes capsulatus.* Further details of the characteristics of the strain isolated from this case are given under another heading.

Case 17.—Private J. S., aged 24, shell wounds of left leg. Wounded May 24. Left leg amputated at site of election on May 26 in France. Admitted, May 31, to Third Northern General Hospital.

Condition on Admission. — The left leg has been amputated apparently by Faraboeuf's method and the stump is gangrenous and œdematous. Left thigh is swollen and of a mottled, marbled appearance; gas is present in the tissues. A thin, foul and dirty-looking fluid is oozing from the gaping flaps. The condition became worse and amputation through the middle of the thigh was performed on June 4. The patient died shortly afterwards.

Bacteriological Examination.—Films made from this discharge showed pus cells and diplococci. The bacillus of malignant œdema was present in large numbers. No aerobic cultures were made. Anaerobic cultures were made in essentially the same fashion as in the other cases of this series. A pure culture of *B. œdematis maligni* was obtained. No other anaerobic micro-organism was found. Although gas formation was observed in the patient's tissues during life, the presence of *B. aerogenes capsulatus* was not demonstrated.

Case 18.—Private C. K., aged 34. Shell wounds of left elbow and thighs. Injuries were sustained on May 31. Field dressings were applied to the wounds. He was sent to a clearing hospital, and later to Lille, where the elbow was opened up and drained. Admitted to Third Northern General Hospital on June 12.

Condition on Admission. — Patient looks ill, has comminuted fracture of lower end left humerus and upper ends of left radius and ulna, the elbow-joint has been opened and is discharging large quantities of foul pus. The wounds of antero-external aspect of upper third of both thighs appear to be nearly healed. On June 26 a fluctuating swelling formed on anterior and outer aspect of the right thigh. On exploratory puncture of the swelling, the piston of the syringe was blown up by gas under tension in the abscess cavity. Pus drawn off and sent for bacteriological examination, and abscess cavity opened up. Patient recovered slowly and was discharged from hospital on July 17.

Bacteriological Examination.—Cells were not numerous in the discharge obtained from this case. The majority appeared to be polymorphonuclear leucocytes, a few of which showed evidence of active phagocytosis. Staphylococci and short chains of streptococci were numerous. There were a few stout Gram-positive rods, with square ends, occurring singly and in pairs, which were considered to be *B. aerogenes capsulatus.*

Aerobic Cultures: From blood agar plates a *Staphylococcus albus* and a streptococcus were isolated.

Anaerobic Cultures: The methods employed were similar to those already described. *B. aerogenes capsulatus* and *B. œdematis maligni* were isolated in pure culture.

GENERAL TABLE.

No. of case	Gas observed in tissues	Symptoms of tetanus	Fatal	*B. œdematis maligni*	*B. aerogenes capsulatus*	*B. tetani*
1	0	+	0	+	+	0
2	+	0	+	+	+	0
3	0	0	0	+	+	0
4	0	0	0	0	0	0
5	0	0	0	+	0	0
6	0	+	0	+	0	+
7	0	0	0	+	0	0
8	0	0	0	+	+	0
9	0	0	0	+	+	0
10	0	0	0	+	+	+
11	0	0	0	+	+	0
12	0	0	0	+	+	0
13	0	0	0	0	+	0
14	+	0	0	+	+	+
15	0	+	0	+	+	0
16	0	+	+	0	+	+
17	+	0	+	+	0	0
18	+	0	0	+	+	0

Comment on Results.

The above eighteen cases came under observation during a period of ten months, from September, 1914, to June, 1915. The patients who provided the material for the investigation had been wounded in various parts of France and Belgium during this period. Although the number of cases is small, the series comprises patients wounded in widely separated districts and under very different climatic conditions.

Under the circumstances the absence of variety in the bacteriological findings is somewhat noteworthy. The cases investigated were those in which there had been gross destruction of tissue, with subsequent necrosis and gangrene. The discharge from the wound was, in the majority of cases, excessively offensive. The aerobic bacteria, which were isolated, call for little comment. Streptococci were isolated from nearly every case. No attempt was made to accurately define the variety of streptococcus, but nearly all those isolated appeared to belong to one type. This micro organism

appeared in films as a small diplococcus, or more rarely as a chain of four or six members. It grew freely on blood-smeared agar and on ordinary agar in small translucent colonies. Films made from blood-agar cultures showed short chains. Staphylococci were isolated less frequently than might have been anticipated. When present they were not as a rule numerous.

Bacillus coli was isolated from four cases. The only other aerobic organism of any interest was the proteus bacillus from case No. 5.

The Anaerobic Bacteria.

The strains isolated were replated several times in order to ensure the purity of the cultures.

With the pure cultures a long series of experiments was made, a summary of which is given below under the separate headings. Only three varieties of anaerobic bacteria were isolated, the *B. aerogenes capsulatus*, the *B. œdematis maligni*, and the *B. tetani.*

These varieties belong to one group of bacteria whose normal habitat is usually stated to be highly cultivated earth and dung; their constant presence in wounds of the type investigated was to be anticipated. With regard to the characteristics of this group of bacteria there are certain points which may be referred to here, and considered more fully under the heading of each variety.

Morphology and Staining Reactions.

(1) *Bacillus aerogenes capsulatus* and *B. œdematis maligni* differ enormously both in shape and in staining reactions under different cultural conditions. The appearances of films of the same strain grown on different culture media differ very greatly, and the identification of either of these varieties from the appearances seen in a film preparation alone is often difficult. The results obtained by Gram's method of staining differ greatly with the nature of the culture medium and the age of the culture. The influence of the variety of culture medium employed on the formation of spores is also well marked.

(2) The relative rate of growth of the different varieties is a matter of some interest from the practical standpoint and is a factor which must be allowed for in any attempt to isolate bacteria of this group in pure culture. In a mixed culture made by inoculating a tube of broth with the discharge obtained from a wound, the different varieties appear after different periods of time, as it

were in crops. After two or three days' incubation the broth may appear to contain a pure culture of *B. aerogenes capsulatus*, after a further period of incubation the *B. œdematis maligni* is often the predominant organism. Tetanus bacilli seem to require a still longer interval for multiplication and may appear first after ten days' incubation. A result of this kind was obtained on several occasions, and in the later cases of the series the original broth culture was subjected to a routine examination at various intervals after inoculation. The preparation of pure cultures was thereby considerably facilitated.

It is possible that a similar method might prove useful in dealing with other groups of bacteria.

(3) The cultural characteristics of the various strains were examined on a variety of media. The appearances of well-isolated colonies on agar and glucose agar plates, the characteristics of the growth on agar, glucose agar, broth, litmus milk and Dorset's egg medium, and the reactions produced with various sugars and alcohols were recorded. A determination of the sugar reactions of these anaerobic bacteria is not without difficulty. The "ordinary sugar media," such as are used in the differentiation of members of the *B. coli*, *B. typhosus* group, which contain one per cent of peptone and one per cent of the "sugar," were at first employed. An anaerobic chamber was employed. Satisfactory results as regards acid formation were obtained with the various strains of *B. aerogenes capsulatus* and the evolution of gas could, if the tubes were suitably arranged, be observed through the walls of the anaerobic chamber. The small inverted tube, commonly used for the collection of gas, cannot be satisfactorily employed in an anaerobic chamber. On the other hand, *B. œdematis maligni* does not grow well in a simple peptone sugar water medium. A series of peptone sugar agar media was prepared and an attempt was made to observe acid and gas formation in deep stab cultures. The controls which contained peptone and agar, without any sugar, and even agar only, were fermented with gas formation by several strains. A similar series of media was then prepared in which gelatine was substituted for agar. The results were not satisfactory. The best results were obtained by the use of "Hiss's serum water sugars," incubated in an anaerobic chamber. In these media acid formation was accompanied by the formation of a gelatinous clot. The clot by its torn and fissured condition afforded satisfactory evidence of the evolution of bubbles of gas.

The Bacillus of Malignant Œdema.

A pure culture of this bacillus was isolated in fifteen of the eighteen cases. All were cases in which considerable laceration and necrosis of tissue had occurred, and all were characterized by an offensive discharge. The degree and extent of the septic process varied considerably in the various cases of the series. Gas formation in the tissues was observed in 4 cases only, in 3 of which *B. aerogenes capsulatus* was also found. Of the 15 cases 3 only were fatal, Cases 2, 16 and 17. In Case 2 there was a large gas-containing abscess of the arm. *B. aerogenes capsulatus* and *B. coli* were also present. Case 16 was one of tetanus. Case 17 was remarkable in that it was the only case of the series in which, although there was abundant gas formation in the tissues, *B. aerogenes capsulatus* was not found. Twelve cases of the fifteen in which *B. œdematis maligni* was found made good recoveries. There is apparently no reason to think that the presence of this micro-organism in a wound is necessarily of serious import. This conclusion is substantiated by the results obtained by the inoculation of animals. Its presence is an indication of the occurrence of gangrene for it has probably little or no capacity for multiplication in living tissue. There appears to be no evidence that its presence is constantly associated with any particular group of signs or symptoms. Many of the films prepared from pus showed that this bacillus is readily taken up by the polymorphonuclear leucocytes.

Cultural Characteristics.

The bacillus of malignant œdema grows extremely well on egg media. When but few are present in the discharge pure cultures are most readily obtained by freely inoculating the egg broth described in an earlier part of this paper and incubating in an anaerobic chamber for five to seven days. The *B. œdematis maligni* may then often be found in very large numbers and pure cultures may readily be obtained by plating on glucose agar.

Slope Culture on Dorset's Egg Medium.—The appearances produced on this medium are very characteristic. A profuse creamy white growth appears within twenty-four hours. It increases rapidly and is at first raised above the surface of the medium. At the end of forty-eight hours or even earlier, liquefaction is noticed. A clear fluid gradually accumulates in the lower part of the tube in which float drops of oil. Liquefaction continues rapidly and a bluish-black discoloration is a well-marked characteristic of

B. œdematis maligni in this medium. The odour is extremely powerful and offensive, it is somewhat suggestive of gorgonzola cheese. Films made from such a culture after incubation at 37° C. under anaerobic conditions for three days showed the following characteristics. The bacilli varied greatly in length, the larger forms, which were the more numerous, were from 8 to 10 μ long and 0·6 μ wide. Of the shorter forms several were observed which measured about 2 μ in length and 0·6 μ in width. The majority of the bacilli occurred singly, but chains of two, four and six members were met with. They were Gram-positive. Many of the bacilli contained spores which were of an oval shape and situated near to one end of the bacillus. Occasionally one bacillus appeared to contain two spores. A contained spore of average size measured 1·5 μ by 1 μ. There were also a comparatively small number of free spores approximately 2 μ long by 1 μ wide. Films made from an egg culture after seven days' incubation showed numerous large, free, oval spores but very few bacillary forms. The bacilli present in these old egg cultures were Gram-negative.

Glucose Agar.—Surface colonies on glucose agar plates showed a central opaque node from which radiated numerous long delicate hair-like processes. Streak cultures on glucose agar slopes showed a central opaque whitish line with delicate hair-like lateral projections. Stab cultures in deep glucose agar tubes are not characteristic. Gas formation is well marked, but usually less than in cultures of *B. aerogenes capsulatus.* Profuse growth occurs along the deeper portions of the needle track. The lateral projections are seldom slender spikes but more often in the form of disc- or coin-shaped, circular, flattened projections. Very similar appearances are seen in stab cultures of *B. aerogenes capsulatus.*

Microscopical Appearances of Films made from a Glucose Agar Slope after Three Days' Incubation at 37° C. under Anaerobic Conditions.—The majority of the bacilli were Gram-negative. Variation in size was even more marked than in the case of the egg culture. The following dimensions, which are fairly representative may be given.

Length	15 μ	..	..	Breadth	0·6 μ
,,	8 μ	..	..	,,	0·8 μ
,,	3 μ	..	..	,,	1·5 μ

Some of the shorter forms resembled oval cocci in outline. The majority were short single rods with rounded ends.

There were also long chains of slender bacilli constituting delicate filaments in which the subdivisions could be distinguished

with difficulty, or not at all. Spores were not found. After eight days' growth on glucose agar the appearances were not greatly different. All bacilli were Gram-negative and stained poorly. There were great variations in length. A few spores were seen.

Agar.—The appearances of surface colonies on plates, slope cultures and in deep stabs are similar to those observed with glucose agar. The growth is less profuse. The microscopical appearances of films from an agar slope after three days' incubation were similar to those seen in films made from the glucose agar culture of the same age. Spores, however, were fairly numerous. After eight days' growth on agar the films showed numerous short forms containing spores and a large number of free spores. The bacteria stained badly and were Gram-negative.

Broth.—On broth rapid growth occurred with the production of turbidity and an offensive odour. After about a week a deposit formed at the bottom of the tube. In broth cultures filamentous forms or chains were frequent and attained a considerable length. Spore formations occurred readily and the older cultures contained more spores than bacillary forms. In young broth cultures the majority of forms were Gram-positive, in older cultures Gram-negative.

Litmus Milk.—After incubation for about seven days under anaerobic conditions very characteristic changes may be observed. When the anaerobic chamber is first opened the contents of the tube are seen in two layers. The upper layer is turbid, but translucent, the lower layer consists of a bulky dirty white deposit. The odour is sour and offensive. If the culture is allowed to stand on the bench for twenty-four hours, colour returns to the upper layer. There are now three well-defined layers. The uppermost layer has a reddish claret colour except at the actual air surface, where a poorly marked blue ring may often be seen. The middle layer is a colourless, translucent, but slightly turbid fluid. At the bottom of the tube is a bulky deposit. On shaking the tube the whole of the contents assume a claret colour. The fluid is amphoteric to litmus paper.

Inspissated Serum.—A whitish growth appears and the medium is slowly liquefied with the formation of a neutral or faintly alkaline fluid. There is no discoloration, but the odour of the culture is offensive.

Sugar Media.—*B. œdematis maligni* ferments glucose and maltose with the formation of acid and gas. Its action on these sugars is less rapid and less violent than that of *B. aerogenes*

capsulatus. Some strains act very slowly, others show a well-marked acid reaction within forty-eight hours. Cane-sugar, lactose, mannite and dulcite remain unaltered. After seven days' incubation under anaerobic conditions the appearance of a tube of serum water glucose or maltose is as follows: At the bottom of the tube is a considerable deposit consisting of flocculi and shreds of torn-up clot. The supernatant fluid is colourless and slightly turbid. At the surface a few shreds of clot of a bright red colour may be seen floating. On shaking, the entire contents of the tube assume a red colour. The culture has an odour suggestive of lactic acid. In the case of some of the strains of malignant œdema, the reaction of the glucose and maltose cultures after incubation was only slightly acid and no clot was formed. In the majority of cases the sugar reactions were recorded shortly after the isolation of the pure culture, and the tests were repeated after the strains had been subcultured for several months. The strain isolated from Case 3 gave the same reactions in June as it had done shortly after isolation in the previous December.

B. aerogenes capsulatus.

This bacillus was isolated from 13 of the 18 cases. In every case but one (No. 13) the bacillus of malignant œdema was also found. It was present in 3 of the 4 cases in which the presence of tetanus bacilli was demonstrated. It was present in 3 of the 4 cases in which signs of tetanus developed in the patient. It was present in 3 of the 4 cases in which gas was present in the tissues. Of the 13 cases only 2 were fatal, and in 1 of these death was due to tetanus.

Isolation.—This bacillus grows readily in broth and egg broth under anaerobic conditions. If the mixed culture, which is prepared from the discharge, be examined after forty-eight hours, large numbers of this bacillus are often found, and a pure culture may readily be obtained by plating on glucose agar.

Morphological and Cultural Characteristics.

In films made from the fluid present in the subcutaneous tissues of a guinea-pig which has succumbed to experimental inoculation, numerous short Gram-positive rods are seen. The majority occur singly and have square ends. The organism also occurs in pairs and chains of four. A capsule can be demonstrated. Many of the bacilli are seen within leucocytes. In some of the films made from the pus obtained from gangrenous wounds, similar short

definitely Gram-positive bacilli occurred. There were, however, other forms somewhat larger, which stained unevenly by Gram's method. These bacilli exhibited a peculiar arrangement of Gram-positive stripes or granules on a Gram-negative ground. Both these and the Gram-positive forms were encapsulated.

Dorset's Egg Medium.—B. aerogenes capsulatus grows excellently on this medium, although not so rigorously as does the bacillus of malignant œdema. The colonies are white, circular, and at first raised above the surface. After three or four days the medium is slowly eroded and the colonies come to lie at the bottom of shallow saucer-like depressions. The digestion of the medium proceeds slowly, but nothing like the rapid liquefaction produced by *B. œdematis maligni* is seen. No discoloration of the medium occurs. Films prepared from a forty-eight hours' slope culture on Dorset's egg medium showed single short Gram-positive rods, of fairly uniform length. There were a few long and comparatively slender forms and a few very short forms which resembled cocci. Spore formation occurs on this medium. The spores which are oval in shape distend the central portion of the bacillus, the remaining cytoplasm of the bacillus appearing as two caps, one at either end of the bacillus. Films prepared from old egg cultures showed great varieties in shape, size, and reaction to Gram's stain. Spores were numerous.

On films made from egg medium, long slender bacilli with a round terminal spore are occasionally met with. These forms closely resemble the tetanus bacillus.

Agar and Glucose Agar.—Isolated colonies on the surface of this medium appear to the naked eye as circular colonies, one to four millimetres in diameter, somewhat opaque, whitish in colour, and definitely thicker in the centre. Viewed under a × 10 lens the centre of the colony is seen to be opaque and raised up above a thin semi-translucent marginal zone which often shows several rings. The margin is slightly wavy, and occasionally the irregularities of the outline are so well marked that an appearance of short offsets or processes is produced. Streak cultures on the surface of a glucose agar slope show a central opaque white line and a marginal, somewhat translucent zone which has a wavy outline. In glucose agar stabs the evolution of gas is commonly so violent that the wool plug and the greater part of the culture medium are expelled from the tube. Under less violent conditions the growth appears as an opaque white streak along the track of the needle from which proceed flat coin-like outgrowths. The

appearances of surface colonies on agar are similar to those on glucose agar except that the growth is less vigorous. Films prepared from agar and glucose agar cultures of the same age show very marked differences. In films made from a forty-eight hours' agar culture short forms predominate. Many of the bacilli are very short, very broad, and present an almost square outline. Clostridial forms occur. The margins of many of the bacilli are indistinct and blurred. The bacilli occur singly. Both Gram-positive and Gram-negative forms may be found, but many show well marked Gram-positive markings on a Gram-negative ground. Films prepared from a forty-eight hours' glucose agar culture showed considerable varieties in the length of individual bacilli, but long forms predominated. There were numerous pairs and short chains, and a few long chains of six, eight, or more bacilli. In older glucose agar cultures numerous club-shaped forms occurred. In neither agar nor glucose agar cultures were spores found.

Broth cultures are in no way characteristic. Uniform turbidity is seen in young cultures. Older cultures show a deposit and a comparatively translucent supernatant fluid. Films prepared from broth cultures showed numerous short, broad rods. The majority occurred singly, but pairs and short chains were not uncommon.

Inspissated serum.—A greyish-white, not very profuse growth makes its appearance. The surface of the medium is very slowly eroded. Films show forms similar to those seen in films prepared from egg medium. Spore formation occurs on this medium. Forms resembling the tetanus bacillus are occasionally met with.

Milk. — The appearances of a litmus milk culture are well known. The production of acid and the formation of a clot are accompanied by a violent evolution of gas. After three or four days the tube is found to contain a clear acid translucent fluid and fragments of gas-contorted clot.

Sugar Reactions.—Violent fermentation occurs in media containing glucose and maltose, with production of acid and much gas. Cane-sugar and lactose are much less readily attacked, and the reaction in media containing these sugars is less acid. No reaction takes place with mannite, dulcite and inulin. The reactions can be demonstrated by the use of ordinary peptone sugar media or by Hiss's serum water sugar media. In the latter media the production of acid is accompanied by the formation of a clot, the disruption of which affords satisfactory evidence of the evolution of gas. The torn and lacerated clot, and the clear, strongly acid fluid, which are found in the serum maltose and serum glucose tubes, present

very characteristic appearances. The sugar reactions of *B. aerogenes capsulatus* were found to be quite constant and were the same in all the strains examined.

Inoculation Experiments.

The results obtained by the inoculation of the mixed growth contained in the original broth cultures have already been recorded under the separate heading of each case. Inoculation experiments were undertaken with eight strains of *B. œdematis maligni* and with five strains of *B. aerogenes capsulatus* in pure culture. In the first series of experiments the inoculated material consisted of either a broth culture or an emulsion in broth of several loopfuls of the surface growth from a Dorset's egg or agar slope. The injections were subcutaneous. Thirteen guinea-pigs and two rabbits were inoculated with cultures of *B. œdematis maligni*. One of these animals died twenty-four hours after inoculation. The cause of death, which could not be ascertained, was probably not the inoculation, for the site of the injection showed only a slight inflammatory reaction. The remainder of the animals survived and remained in good health for one month after the inoculation. In a few cases there were signs of illness during the first forty-eight hours, and examination revealed a slight swelling at the site of inoculation. Recovery was in these cases rapid and apparently complete. In the first series of experiments with *B. aerogenes capsulatus* twelve guinea-pigs and two rabbits were used. Two guinea-pigs which had been inoculated subcutaneously at 5 p.m. on November 25 with two cubic centimetres of a broth culture of *B. aerogenes capsulatus* from Case 2 were found dead at 9 a.m. on November 26. Emphysema was found at site of inoculation, and the skin had been separated from the deep tissues over the greater part of the trunk. The subcutaneous tissues were infiltrated by a blood-stained fluid in which floated globules of fat. Gas was present in the subcutaneous tissues but not in the organs of the thorax and abdomen. Films made from the site of inoculation contained large numbers of *B. aerogenes capsulatus*, and a pure culture of this bacillus was obtained from the exudate. The heart blood was sterile. On December 11 a guinea-pig received a subcutaneous injection of one cubic centimetre of a broth culture of the same strain (Case 2). The animal was found dead on December 15. Necrosis of tissue was found at the site of the injection and films showed *B. aerogenes capsulatus* and numerous streptococci. All the organs of the

body and the serous membranes were engorged with blood. The lungs showed patchy consolidation. Films made from the lung showed streptococci only. The heart blood was sterile. On December 11 a guinea-pig received a subcutaneous injection of one cubic centimetre of a broth culture of *B. aerogenes capsulatus* (Case 3). Slight local swelling and gas formation followed. The animal had apparently completely recovered after forty-eight hours. It died on December 18. At the post-mortem examination an acute volvulus of the small intestine was found. In two additional experiments with pure cultures from strain No. 2, the animals remained in perfect health for two months. Similar experiments were performed with pure cultures from Cases 10, 12, 13, and 14. In each case two guinea-pigs were inoculated. One of the animals inoculated with strain 13 died after twenty-four hours from typical gas gangrene. The remaining seven animals were kept under observation for more than a month and showed no evidence of infection. Two rabbits received a subcutaneous injection of two cubic centimetres of a pure culture of strain 2. After twenty-four hours there was a slight local swelling and the animals appeared to be slightly unwell. Recovery had taken place at the end of forty-eight hours and no further symptoms were observed.

The conclusion arrived at from these experiments was that the subcutaneous injection of pure cultures of *B. aerogenes capsulatus* may occasionally give rise to fatal gas gangrene. With possibly one exception all the experiments with pure cultures of *B. œdematis maligni* yielded negative results.

The results obtained by animal inoculation with pure cultures accord well with the evidence afforded by the clinical findings in the various cases above recorded. Both *B. œdematis maligni* and *B. aerogenes capsulatus* were present in the majority of the cases; but three only of the eighteen patients died, and in four cases only was gas formation observed in the tissues. We must assume that neither of these micro-organisms is truly parasitic, that is to say, neither bacillus is capable of multiplication in living tissue. In blood-clot, in dead tissue, and fragments of foreign bodies which are so often present in wounds, these micro-organisms are capable of active growth and multiplication. Here they produce by ferment action, poisonous substances,[1] possibly organic acids,

[1] After our paper had been sent to press there appeared in the *British Medical Journal* of December 4 a "Note on a supposed Soluble Toxin, produced in Artificial Culture by the Bacillus of Malignant Œdema," by G. Barger and H. H. Dale. These workers have been able to prove that the "poisonous substances," the presence of which we suspected, are ammonium salts.

which, under favourable circumstances, diffuse out into the surrounding living tissue. The result is that the adjacent tissues die and are then invaded by the micro-organisms. In this fashion the gangrenous area increases in size, successive zones of tissue being first poisoned and then invaded by the saprophytes.

Acting on the assumption that the pathogenic action of these micro-organisms might be dependent on the action of the organic acids which they produce, the following experiments were undertaken:—

B. œdematis maligni (strain 3) and *B. aerogenes capsulatus* (strain 2) were subcultured on agar, broth, Dorset's egg medium, and on serum water cane-sugar, glucose, lactose, maltose, mannite, and dulcite. In the case of *B. aerogenes capsulatus* marked acid reactions were obtained with glucose and maltose, and less marked reactions with cane-sugar and lactose. In the case of *B. œdematis maligni* the media containing glucose and maltose became slightly acid. A portion of each medium was injected into a guinea-pig. In the case of the fluid media the quantity inoculated was two cubic centimetres; in the case of the solid media one loopful of the growth was emulsified in two cubic centimetres of broth. It was thought that the cultures which contained acid might prove the more pathogenic. The result of the experiment was negative. In no case was gangrene produced, and with the exception of slight and transient symptoms, all the animals remained in perfect health. In a third series of experiments guinea-pigs were inoculated with various strains of *B. œdematis maligni* and *B. aerogenes capsulatus* mixed with a recently isolated strain of *Staphylococcus aureus*. It was thought that the anaerobic bacteria might gain a hold in the tissue damaged by the action of *S. aureus*.

The results obtained in the above series of inoculations were not very conclusive. Possibly a more interesting result might have been obtained by the use of a more virulent culture of *S. aureus*. Of the eighteen animals, two died with typical gangrene around the site of inoculation. Both of these animals (No. 4 and No. 8) had been inoculated with a mixture of *B. œdematis maligni* and *S. aureus*. The control animals (No. 3 and No. 7), which were inoculated with the same strains of *B. œdematis maligni* and *S. aureus*, did not develop gangrene. On the other hand, two other guinea-pigs (No. 2 and No. 6) which were inoculated with a mixture of *S. aureus* with the same strain of *B. œdematis maligni* as was used in experiment No. 4 did not develop gangrene. In the case of several of the patients recorded

in this series, pieces of clothing were removed from the depth of the wound. It is presumed that such fragments, which must be often covered with mud and impregnated with anaerobic bacteria or their spores, may often form the starting point of gangrene.

SERIES 3.

No.	Strain	Date of inoculation	Result
1	*B. œdematis maligni*, strain 8, alone	May 27	No symptoms. Alive and well, July 1.
2	*B. œdematis maligni*, strain 8, + *S. aureus*	,,	,, ,, ,, ,,
3	*B. œdematis maligni*, strain 8, alone	,,	,, ,, ,, ,,
4	*B. œdematis maligni*, strain 8, + *S. aureus*	,,	Ill and local swelling May 29. Died June 2; gangrene of subcutaneous tissues, blood-stained rancid effusion. Films showed pus cells, cocci and *B. œdematis maligni*.
5	*B. œdematis maligni*, strain 8, alone	,,	No symptoms. Alive and well July 1.
6	*B. œdematis maligni*, strain 8, + *S. aureus*	,,	No local symptoms. Died June 14. No lesion at site of inoculation. No obvious cause of death.
7	*B. œdematis maligni*, strain 2, alone	,,	Died June 12. No local lesion. No obvious cause of death.
8	*B. œdematis maligni*, strain 2, + *S. aureus*	,,	Died May 28. Swelling and œdema at site of inoculation. Film numerous cocci and *B. œdematis maligni*.
9	*B. œdematis maligni*, strain 15, alone	,,	No symptoms. Alive and well July 1.
10	*B. œdematis maligni*, strain 15, + *S. aureus*	,,	Died June 21. No local lesion. No obvious cause of death.
11	*B. œdematis maligni*, strain 15, alone	,,	No symptoms. Alive and well July 1.
12	*B. œdematis maligni*, strain 15, + *S. aureus*	,,	May 29, local swelling. May 30, local swelling marked; animal very ill. May 31, much better. Recovered and quite well July 1.
13	*B. aerogenes capsulatus*, strain 2, alone	,,	May 28, local swelling, animal ill. May 29, swelling disappeared, animal well; recovered completely. Alive and well on July 1.
14	*B. aerogenes capsulatus*, strain 2, + *S. aureus*	,,	May 29, local swelling; animal slightly unwell; recovered completely. Alive and well on July 1.
15	*B. aerogenes capsulatus*, strain 3, alone	,,	Died June 18, no local lesion. No obvious cause of death.
16	*B. aerogenes capsulatus*, strain 3, + *S. aureus*	,,	No symptoms. Alive and well on July 1.
17	Control *S. aureus* alone ..	,,	No symptoms. Alive and well on July 1.
18	Control *S. aureus* alone ..	,,	No symptoms. Alive and well on July 1.

In the following four experiments an attempt was made to reproduce these conditions by the introduction of a foreign body heavily charged with anaerobic bacteria. Splinters about a quarter of an inch long were prepared from wooden matches and impregnated with cultures of *B. aerogenes capsulatus* and *B. œdematis maligni*. They were then introduced into the subcutaneous tissues of guinea-pigs.

SERIES 4.

No.	Strain	Splinter inserted	Result
1	*B. œdematis maligni*, strain 8 ..	June 26	The animal was well on June 28. Marked swelling developed around splinter on June 29. On June 30 animal was very ill. Subsequently complete recovery occurred.
2	,, ,, ,, ..	,,	June 28, marked swelling around splinter; animal ill; June 29, died. Inflammation and œdematous infiltration around splinter.
3	*B. aerogenes capsulatus*, strain 2	,,	Well until June 30, when marked swelling around splinter developed. The guinea-pig was very ill but completely recovered.
4	,, ,, ,,	,,	No symptoms developed.

The series of inoculation experiments with these strains of *B. œdematis maligni* and *B. aerogenes capsulatus* led to the following conclusions:—

(1) The subcutaneous injections of pure strains does not, as a rule, produce any sign or symptom of disease.

(2) If the tissues are damaged by a parasitic micro-organism, foreign body, or other irritant, the introduction of *B. aerogenes capsulatus* or *B. œdematis maligni* may in a comparatively small number of cases lead to local gangrene and the death of the animal.

TETANUS.

No. of case	Symptoms of tetanus in patient	Prophylactic injection of anti-serum	Presence of *B. tetani* proved by inoculation	Number of days required for bacteriological diagnosis	Other anaerobic bacteria present
1	+	0	0	—	*B. œdematis maligni* and *B. aerogenes capsulatus*.
6	+	0	+	19	*B. œdematis maligni*.
10	0	+	+	6	*B. œdematis maligni*.
14	0	+	+	15	*B. œdematis maligni* and *B. aerogenes capsulatus*.
15	+	0	0	—	*B. œdematis maligni* and *B. aerogenes capsulatus*.
16	+	0	+	13	*B. aerogenes capsulatus*.

The methods which were employed with the object of establishing a bacteriological diagnosis of tetanus fall under three headings:—

(1) The microscopical examination of (*a*) films from the discharge from the wound, (*b*) films from the original mixed culture prepared by the inoculation of broth with the discharge.

(2) The inoculation of guinea-pigs with the original mixed culture.

(3) The isolation of *B. tetani* in pure culture.

(1) *Examination of Films.*—In none of these cases were bacteriological forms resembling *B. tetani* found in films made from the discharge. In the films made from mixed broth cultures, tetanus forms were observed in Cases 6, 10, 14 and 16, and also in Case 1. By the expression "tetanus form" is implied a slender Gram-positive rod bearing a large absolutely terminal round spore. Microscopical examinations of films from the original broth culture of Case 15 were made on numerous occasions but no forms resembling tetanus were observed. In Cases 6 and 16 tetanus forms could not be demonstrated until the mixed culture had been incubated under anaerobic conditions for a relatively long period. Unfortunately, no systematic attempt was made to record the number of days which elapsed in each case before bacteria resembling tetanus appeared in the broth cultures.

The following observations were, however, recorded:—

Case	Tetanus forms not present after	Tetanus forms present after
1	—	2 days
6	6 days	17 ,,
10	—	4 ,,
14	3 days	8 ,,
16	5 ,,	10 ,,

It appears that: (*a*) Tetanus bacilli are not often found in films made from the discharge from the wound.

(*b*) A long time may elapse before they appear in cultures in sufficient number for microscopical recognition.

A more serious objection to the microscopical method of diagnosis is the fact that closely similar, if not indistinguishable forms occur in films made from pure cultures of *B. œdematis maligni* and *B. aerogenes capsulatus*. On the other hand, a pure culture of *B. tetani* may often contain many bacilli which are in no way characteristic in appearance. In the absence of other evidence, the discovery of tetanus-like bacilli in films is not

satisfactory evidence of the presence of *B. tetani*. The presence in a film of numerous slender Gram-positive bacilli, bearing a large round terminal spore, is of course a suspicious circumstance, and may justify a preliminary opinion. The microscopical evidence is, however, not sufficient unless supported by the result of an inoculation experiment.

(2) *Inoculation of Mixed Broth Culture.*—The presence of *B. tetani* was demonstrated in Cases 6, 10, 14, and 16, by injecting a guinea-pig with the original mixed broth culture.

One or two cubic centimetres of the culture were injected beneath the skin on the left side of the chest. After a variable interval, usually two or three days, slight stiffness of the forelimb nearest to the site of inoculation was observed. Within a few hours the limb became rigid in a position of extreme extension. Subsequently a condition of extensor spasm spread to the other limbs and the muscles of the neck and back. Death usually occurred within twenty-four to forty-eight hours after the first onset of symptoms. In the majority of cases there was little or no evidence of inflammation at the site of inoculation. The method is a satisfactory one and yields results which are not open to doubt. The disadvantage is the considerable interval that may elapse before a demonstrable amount of toxin is produced.

(3) *Isolation of Pure Cultures.*—In Cases 6, 10, 14, and 16, tetanus bacilli were found in large numbers in the original mixed broth cultures and the inoculation of these broth cultures produced characteristic symptoms in animals. In only one of these cases was the tetanus bacillus isolated in pure culture, in the other three cases repeated attempts ended in failure. Agar, glucose agar, and blood agar plates were employed; colonies of *B. œdematis maligni* were readily obtained but not of tetanus. Fractional heating was employed in the hope that the spore of tetanus might prove more resistant than that of malignant œdema. No success was obtained in this way. A pure culture was eventually obtained by the inoculation of glucose agar plates with the mixed broth culture from Case 16.

Cultural Characteristics.

The surface colonies on glucose agar plates varied greatly in size. They were round, opaque, and rather white. Under a hand lens they showed a central portion which was thicker and made up the greater part of the colony, surrounded by a thin translucent

margin which had a wavy outline. With higher magnification the centre of the colony was seen to be granular, while the margin showed delicate rounded projections. In older cultures numerous small circular opaque nodes or thickenings appeared on the colony. These may perhaps, be described as secondary colonies. Other colonies showed large branching outgrowths, which were beautifully rounded and somewhat suggested the contour of an oak leaf. Streak cultures on glucose agar slopes showed a central thick opaque line and a broad translucent margin showing branching and rounded processes. The appearance of agar cultures was similar, but the growth was not so vigorous. Broth cultures became turbid with the formation of a deposit. The growth on Dorset's egg medium was not very vigorous, but resembled that on glucose agar. Flat white colonies appeared, which after a time came to lie in shallow depressions in the medium. No change was produced in litmus milk. The sugar reactions were examined on several occasions with Hiss's serum water, and with peptone water media. This strain produced no change on cane-sugar, glucose, maltose, lactose, mannite, dulcite, and inulin.

The microscopical appearances of films from various culture media were recorded. As only one strain was examined the results have but little value. The appearance of bacilli grown on agar, glucose agar and broth accorded with the description usually given of this micro-organism. The bacilli were slender, showed considerable variations in length and size, and had rounded ends. The majority occurred singly. Many bacilli contained spores, the majority of which were terminal, round, and very large. In a very few bacilli the spores were oval in shape and were either in the centre of the bacillus or near, but not actually at, one end. These forms showed a close resemblance to the appearances commonly met with in cultures of *B. œdematis maligni*. In a few of the bacilli there was an appearance of granules similar to that seen in films of *B. aerogenes capsulatus*. Bacilli which appeared to have two terminal spores occurred occasionally. Films made from a three-days'-old culture on Dorset's egg medium were distinctly different in appearance. The majority of the bacilli appeared to be broader than those grown on agar. Although in many bacilli the spore was terminal, there were many others in which it was oval and occupied a central position. Apart from the spore-bearing forms, bacilli occurred in which the poles stained faintly while the centre appeared as a solid deeply stained band. In other bacilli the arrangement was reversed and a bipolar effect was produced.

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Possibly these appearances represent early stages of spore formation.

Inoculation Experiments.

Eleven guinea-pigs and two rabbits were inoculated from a ten-day-old pure broth culture of this strain. Tetanus developed in four of the guinea-pigs. The other seven guinea-pigs and the two rabbits showed no evidence of the disease.

Remarks on above Cases of Tetanus.

It is perhaps worthy of note that the two patients, who did not suffer from tetanus although the presence of tetanus bacilli was demonstrated in the wounds, had received a prophylactic injection of antitoxin. The four patients who developed signs of tetanus do not appear to have received a prophylactic injection. In Cases 10, 14, 15, and 16 fragments of clothing were removed from the wound. It may be assumed that the presence of fragments of cloth, saturated with the discharges of a gangrenous wound, must form a peculiarly suitable nidus for the growth of tetanus bacilli.

The results above recorded lead to the conclusion that the microscopical examination of films made from the discharge from a wound may be of little value in the diagnosis of tetanus. Satisfactory results may be expected from the injection of guinea-pigs with broth which has been inoculated from the discharge. Prolonged incubation may, however, be necessary before a positive result is obtained. Under these circumstances the patient may develop tetanus before a diagnosis is arrived at in the laboratory. Now the tetanus bacillus belongs to the same group of bacteria as do *B. aerogenes capsulatus* and *B. œdematis maligni*, and the demonstration of the presence of these two micro-organisms is a relatively simple and rapid matter. All three micro-organisms are of intestinal origin and are apt to be found in polluted soil. All three are no doubt frequently simultaneously introduced into a wound, and all three require the same conditions for growth and multiplication. The presence of either *B. aerogenes capsulatus* or *B. œdematis maligni* might, with great advantage, be taken as an indication for one or more prophylactic injections of antitoxic serum. In two at least of the above cases the first symptoms of tetanus followed immediately on an operation, and it appears to us that anti-tetanic serum should be injected as a prophylactic measure before any considerable operative procedure is attempted on a patient with a gangrenous wound.

Since the conclusion of this investigation two other cases have been observed in which the onset of tetanic symptoms was apparently determined by operative procedure.

TREATMENT.

In the above summary of our cases no reference has been made to treatment, and we did not in the first instance contemplate any reference to the matter. It will, however, be noted that the results obtained were, considering the gravity of the majority of the cases, satisfactory, and as the bacteriological findings exhibited a marked uniformity, a brief note on the general lines of treatment may be of some interest. Cases 17 and 18 received hypertonic saline treatment. In the other sixteen cases treatment consisted of irrigation with hydrogen peroxide (five to ten volumes), and fomentations of hot sterile isotonic saline solution (0·9 per cent) or of boracic lotion. In the later stages when the wounds had cleaned up lotio rubra and gauze dressings were employed.

After the conclusion of this investigation, continuous irrigation with hypertonic saline solution was employed in more than a hundred cases which presented similar features to those above recorded. The method caused considerable discomfort to the patients and did not yield results in any way superior to those obtained by the use of older methods of treatment. In this connexion it may be noted that active phagocytosis was often observed in films prepared from the discharge of wounds which had been treated by the usual methods.

Bacillus aerogenes capsulatus and *B. œdematis maligni* were frequently isolated from wounds in which no gas was produced and the gangrenous area showed no tendency to spread. It may be inferred that the conditions which enable these micro-organisms to exercise any serious influence in the course of a case are only exceptionally present. These micro-organisms are essentially saprophytes, and are relatively, if not entirely, innocuous to undamaged living tissues. The presence of dead tissue or fragments of clothing, and the retention of discharge or blood-clot within a wound provide these micro-organisms with a favourable culture medium. It is of the utmost importance that wounds containing anaerobic bacteria should be freely opened up and thoroughly drained.

SUMMARY.

(1) The series comprises 18 cases of gangrenous wounds, of which 3 only were fatal. Included in this total are 4 cases of tetanus,

1 of which was fatal, and 4 cases of gas gangrene, 2 of which were fatal. Of the 18 cases *B. œdematis maligni* was found in 15, and *B. aerogenes capsulatus* in 13.

(2) *B. aerogenes capsulatus* and *B. œdematis maligni* are apparently possessed of powerful enzymes. The former is peculiarly able to attack carbohydrates, the latter proteins. Dorset's egg medium is an admirable medium for both micro-organisms.

(3) The shape, size, staining reactions, and capacity for spore formation of these bacilli are profoundly influenced by the nature of the culture medium.

(4) On Dorset's egg medium the majority of the bacilli are typical in shape, uniform in size, and Gram-positive. On media which contain a carbohydrate, from which the bacilli can form acid, growth is at first rapid and vigorous, but after a few days the bacilli become atypical in appearance, vary greatly in size, and the majority are Gram-negative.

(5) *B. aerogenes capsulatus* forms spores on Dorset's egg medium and inspissated serum, but not on media in which an acid reaction is produced. *B. œdematis maligni* forms spores less readily in acid media.

(6) The presence of *B. aerogenes capsulatus* and *B. œdematis maligni* is not necessarily associated with the development of gas in the tissues.

(7) *B. œdematis maligni* and *B. aerogenes capsulatus* are essentially saprophytes. They have little or no power to multiply in living tissue. In dead tissue they grow rapidly and produce poisonous substances, by which the adjacent living tissue is destroyed and rendered a suitable medium for the further multiplication of these bacilli.

(8) *B. tetani* was not found in films made from the discharge in any one of the six cases of this series in which it was present.

(9) The recognition of *B. tetani* by purely microscopical methods is complicated by the fact that slender Gram-positive rods bearing an absolutely terminal spore may be occasionally found in pure cultures of *B. œdematis maligni* and *B. aerogenes capsulatus*. Moreover, pure cultures of tetanus bacilli, especially cultures on egg medium, often contain many atypical forms.

(10) If broth is inoculated with material from the wound in a case of tetanus, and incubated under anaerobic conditions, the presence of *B. tetani* can often be satisfactorily demonstrated by animal inoculation. Such a broth culture should be examined at intervals, and two or three weeks may elapse before *B. tetani* can be demonstrated.

(11) The presence of *B. tetani* was demonstrated in the discharge from the wounds of two patients who did not develop signs of tetanus. Both had received prophylactic injections of antitetanic serum.

(12) The discovery of *B. tetani* in the wounds of a patient who had not developed tetanus would obviously be an indication for one or more prophylactic injections of antitetanic serum. But the practical utility of such a procedure is limited by the difficulty and delay which attend the bacteriological recognition of this bacillus. Now *B. tetani* belongs to the same group of anaerobic bacteria as *B. aerogenes capsulatus* and *B. œdematis maligni.* All three have probably a common source, and the conditions favourable to their growth within a wound are probably identical. The demonstration of either *B. œdematis maligni* or *B. aerogenes capsulatus* is a relatively simple matter and does not involve much delay. The discovery of either of these bacilli might with advantage be followed by a prophylactic injection of antitetanic serum.

(13) A prophylactic injection of antitetanic serum should be given before any considerable operation is performed on a patient with a gangrenous wound.

REPORT ON CASES OF ALBUMINURIA AMONGST BRITISH TROOPS IN FRANCE.

By Major B. W. HOGARTH.

Royal Army Medical Corps.

This Report deals with seventy-five cases of "albuminuria." Some of these obviously were not cases such as were being considered under that title and it was necessary to separate the cases which there was reason to suppose were suffering from nephritis from those which had no symptoms pointing to a definite nephritis. I therefore rejected cases which had not either *dropsy*, or more than a *trace* of albumin in the urine, or hæmaturia. There remained fifty cases of nephritis.

I append a detailed account of the history of each case classified for easy reference under various headings. I have since questioned the wisdom of this course and I append histories of some of the rejected cases to show that apparently one set of cases shaded into the other. On the other hand, all the fifty accepted cases do not belong to the same category.

It will at once be noticed that amongst the seventy-five cases there is *no officer*. It is hardly possible that an officer suffering from dropsy and the severe constitutional symptoms which have accompanied most of the cases would not have reported sick; we may therefore conclude that no officer was attacked.

	Age	Cases
Age-incidence	25 years and under ..	20 = 40 per cent.
	26 to 35	23 = 46 ,,
Over ..	35	7 = 14 ,,
Or over ..	30	20 = 40 ,,
Or if taken	25 years and under ..	20 = 40 ,,
Over ..	25	30 = 60 ,,

As it can hardly be supposed that sixty per cent of the British Army in the Field is over 25 years of age we are forced to the conclusion that *age is a powerful predisposing factor*. The length of time spent in France is :—

Under 6 months	.. .. ..	21 cases.
,, 9 ,,	.. .. ..	34 ,,
Over 9 ,,	.. .. ..	16 ,,
,, 6 ,,	.. .. ..	29 ,,

Occupation.—The great bulk of them were occupying the trenches. But Cases 11, 26, 39, 49, 44 were never or only very exceptionally actually in the *trenches or dug-outs*, so that trenches

and dug-outs in themselves may apparently be *ruled out* as predisposing causes.

Habits as regards Food and Drink (particularly Beer).—It was almost universal for men to say that they simply ate what the others did and in this case the reply is indicated by N. in the schedule. Some few stated that they had eaten largely of tinned salmon, sardines, etc., and one case, No. 11, was a vegetarian. As regards beer or arsenic in the beer, this may be at once disposed of by the fact that *thirteen cases* were *total abstainers.* Also the annexed schedule of Analyses of Specimens of Urine, made at the Base Hygiene Laboratory, show that with the exception of one case, No. 24, sample 3, neither arsenic, borates, salicylates, nor chlorates were present in the urine. The specimens were all taken from the first urine passed after admission.

Chlorination of Water.—Close questioning of the men elicited the information that water-carts were not the usual supply of the men. Some stated it had tasted funny—one (Case 36) was disposed to regard it as the cause of his illness. But even so, the water was usually *taken as tea* and this would dispose, one would think, of much of the chlorine if present, by the necessary boiling.

Smoking.—No single man stated he was a non-smoker.

Mosquitoes, Lice, etc.—Most of the men admitted to being much mosquito-bitten and from personal observation and experience I can assert that the mosquitoes were very active. As regards lice, practically *all the men are lousy,* so that no differentiation can be made in this respect.

Onset.—One case, with marked dropsy of the face and heavy cloud of albumin, stated he was not ill and never had been, but the great majority were taken suddenly and violently ill at a definite hour which they named. One or two had prodromal symptoms, e.g., Case 48. The usual onset was for the patient to be seized with giddiness, rigors, headache, abdominal pain, and very often he vomited. Next day or the day after he noticed his face was swollen or his urine bloody. Dyspnœa soon came on and in some cases was the first symptom noticed. Initial symptoms were distributed as follows :—

Giddiness	11 times.
Nausea and vomiting	11 ,,
Dyspnœa	13 ,,
Abdominal pain	7 ,,
Rigor	11 ,,
Dropsy of face	6 ,,
Backache	9 ,,
Vesical tenesmus	5 ,,

These figures do not indicate the number of times these symptoms occurred during the course of the disease, but purely when they occurred as initial symptoms. Headache, e.g., was common to nearly all the cases mostly as an initial symptom, backache also, and *pains all over* were sooner or later common to all. Tenderness over the kidneys was mostly found when looked for.

Two cases only were really very ill, the majority were only feeling slightly ill by the time they reached this ambulance.

The Test used for Albumin.—The test-tube was almost filled with urine and held by the bottom and the top boiled, and a drop of acetic acid (dilute) was then added. If a cloud remained on shaking another drop of acid was added and the tube again shaken ; if a cloud still remained, albumin was considered to be present. The investigation taking place in a field ambulance it was impossible to look for casts, etc. *Blood*, no doubt, was present in many of the cases, but is not recorded unless it was obvious to the naked eye.

Pyrexia was present in thirty-three cases. One case reached 105° F. ; Another case reached 104° F. Fourteen cases reached 102° F. and over.

Exposure.—As soldiers, almost all the cases had considerable amount of exposure. Some, indeed, had not been exposed to any extent and one case (Case 12) actually said he had not been exposed nearly so much here as at home.

Definite exposure, apparently directly connected with the attack, was made out in no fewer than seventeen cases. Exposure was definitely excluded in fifteen cases. In the remainder of the cases there was generally a history of excessive sweating on the march up to the trenches, or some other form of exertion, followed by standing still or lying in their damp clothes on cold ground without blankets. The sudden and great alteration in surface temperature under these circumstances appears to me to be the great predisposing cause of the illness.

Scarlet fever or other disease likely to have set up the nephritis was closely looked for, and in only one case, No. 19, could scarlet fever be suspected, and in only one case, No. 43, was enteric fever likely.

With reference to the question before remarked upon, as to whether the whole fifty cases come under the same category, it may at once be conceded that there is a wide difference between such cases as Nos. 3, 9, 39, 44, where dropsy, without rise of temperature or other sign except highly albuminous urine, and with little constitutional disturbance, was the initial and almost

only sign of illness, and cases such as 13, 18, 21, 24, 27, 45, and 49, where sudden violent onset with high temperature remind one of such diseases as small-pox and influenza, but there are gradations from one type to the other. Moreover, it is difficult to find a *natural* dividing line between the six rejected cases *quoted* (there were others I have not recorded) and such cases as Nos. 26, 27, 32, 35, 42, 45 which I have included.

In conclusion, as a series of cases they are most aptly compared with pneumonia which, although an acute specific disease, is greatly predisposed to by chill.

We apparently have here an acute specific disease characterized by sudden violent onset with high temperature, rigor, vomiting or nausea, headache, general pains, and giddiness, followed quickly by dyspnœa and dropsy, blood and albumin in the urine and tenderness of the kidneys running a short course with great tendency to recovery.

Note 1.—All cases were evacuated the day after admission, hence the lack of subsequent history.

Note 2.—With reference to the suggestion that a trace of albumin is a common thing in a soldier's urine. The urine of *all* sick admitted to No. 2 Field Ambulance during the period covered by this report was examined on admission; they were some hundreds in number, 793. Albumin was *not found in any* case except those in which it was connected with the present series or was regarded as febrile when occurring as a slight trace in those cases variously designated as trench fever, pyrexia not yet diagnosed, influenza, or pyrexia of uncertain origin.

No. of case	Regimental No.	Rank and name	Age	Months in France	Date of illness	First symptom	Temperature on admittance	Date of admission
1	6172	Pte. R. ..	40$\frac{4}{12}$	4	15.7.15	Vesical tenesmus..	Normal	18.7.15
2	66766	Drvr. W. ..	24	11	15.7.15	Dyspnœa	,,	18.7.15
3	3224	Serjt. H. ..	33	8	22.7.15	Dropsy of face ..	,,	22.7.15
4	4731	Lance-Cpl. J. E.	32	7	17.7.15	Pains in lumbar region	99°	22.7.15
5	7380	Pte. J. R. ..	29	8	(?)19.7.15	Dyspnœa	(?)	22.7.15
6	6166	Serjt. T. J. ..	23	8	16.7.15	Vesical tenesmus	(?)	22.7.15
7	2985	Pte. P. ..	25	4½	19.7.15	,, ,,	(?)	21.7.15
8	3086	Pte. A. L. ..	19	4½	18.7.15	Pains in back ..	Normal	22.7.15
9	7207	Drummer J. W.	21	11½	24.7.15	Dropsy of face ..	,,	27.7.15
10	18698	Lance-Cpl. A. R.	30	2	21.7.15	Vomiting	98°	26.7.15
11	25765	Drvr. J. B. ..	26	11	23.7.15	Pains in back ..	Normal	26.7.15
12	19305	Pte. J. H. ..	30	3	24.7.15	Vesical tenesmus, headache	100·6	26.7.15
13	3327	Lance-Cpl. C. S. B. L.	31	8	25.7.15	Nausea	105°	29.7.15
14	1184	Pte. A. M. ..	32	2	25.7.15	Dropsy in arms and legs	98°	28.7.15
15	8077	Pte. D. J. ..	29	3	20.7.15	Rigor and abdominal pain	Normal	,,
16	21481	Sapper J. G. ..	25	5½	28.7.15	Vesical tenesmus, pains in back	100°	1.8.15
17	2429	Pte. P. M. ..	22	6 and 3	31.7.15	Backache	99·6°	4.8.15
18	12719	Pte. W. S. ..	40	7	1.8.15	Rigor, backache ..	102°	4.8.15
19	11234	Pte. B. S. ..	21	7	1.8.15	Sore throat, headache, and pains all over	103°	4.8.15
20	2298	Lance.-Cpl. J. K.	27	5	1.8.15	Extreme dyspnœa, œdema face, and abdominal pain	99·6°	7.8.15 to No. 1 5.8.15
21	7667	Pte. J. F. ..	21	6	28.7.15	Giddy and faint; pains, back and abdomen	103·8°	6.8.15
22	80334	Drvr. F. S. S.	19½	3	27.7.15	Dyspnœa, rigor, abdominal pain	97°	7.8.15
23	11702	Pte. E. H. ..	35	6	1.8.15	Dropsy of face; headache	98·8°	8.8.15
24	11922	Pte. W. J. W.	43	8	2.8.15	Feverish pains all over	102°	8.8.15

Dropsy	Habits as regards food and drink	Amount of albumin in urine	Remarks as regards cause, etc.	No. of case
Face and hands	Moderate beer-drinker, food as other men	Urine almost solid on boiling	This patient was very ill and traced his disease definitely to getting wet through	1
None	Temperate and normal	Thick cloud..	Definite history of sleeping in wet clothes just before being taken ill	2
Face and legs..	Almost teetotal, food normal	,, ,, ..	Has *not* slept in wet clothes; previously had bronchitis for years	3
,, ,,	Almost teetotal, food normal	Moderate cloud	Slept in wet clothes 14 days before being taken ill; has suffered from bronchitis all the time he was in France	4
,, ,,	Drank little beer, food normal	Thick cloud..	Slept in wet clothes 3 weeks ago; dyspnœa a fortnight before admission	5
,, ,,	Drank little beer, food normal	Heavy trace	Dyspnœa marked: never been ill before; slept in wet clothes 3 weeks before admission	6
None	Drank little beer, food normal	Moderate cloud	Owing to enuresis was always wet through	7
Legs	Life abstainer, food normal	None previously found in No. 1 F. A.	Has not been wet: has eaten a lot of tinned salmon and sardines	8
Face and arms	Drank little beer, food normal	Urine solid on boiling	Not been wet; has had a little bronchitis since the attack; no dyspnœa; has never been ill in his life before	9
Face, legs and arms	Total abstainer, food normal	Thick cloud	Marked dyspnœa; has not been wet or constipated or had bronchitis	10
Face and arms	Temperate; vegetarian except he took a little broth	,, ,,	Marked dyspnœa; has never been ill before; has never been wet through, but sweated excessively	11
Face, legs and arms	Total abstainer, food normal	Heavy trace	Has been wet, but nothing so bad as at home, where he was always wet through and well; feet running with sweat and painful	12
None	Drinks beer, food normal	Heavy cloud and blood	No cause such as exposure to be made out; vomiting marked	13
Legs, arms and face	Drinks little beer, food normal	Heavy cloud	Not exposed more than usual	14
None now ..	Little beer, food normal	Slight cloud	Was working up to his waist in water for 2½ hours; had the same disease on November 14	15
Face, legs, and arms	Nearly abstainer, food normal	Heavy cloud	Has been continually wet through mining in chalk	16
Arms	Drinks three pints beer a day, food normal	Slight cloud	Slept in clothes wet through two days before onset	17
Face and legs ..	Moderate beer, food normal	,, ,,	Continually wet during mining operations	18
None	Total abstainer, food normal	Blood and albumin	No cause to be made out; (?) scarlet fever	19
Face	"Practically teetotal," eaten largely of tinned salmon, etc.	Heavy cloud	Wet through and sleeping in wet dug-out; the dyspnœa amounted to orthopnœa as the first symptom .. .. Sample 1 to Boulogne Hygienic Laboratory	20
Slight in legs ..	Drinks a pint of beer in a week, food normal	Blood and heavy cloud	Sweated heavily and sleeping in damp clothes; dyspnœa moderate .. .. Sample 4	21
Face, legs, arms	Total abstainer, food normal	Heavy cloud	Slept in wet clothes two days before ill .. .. Sample 2	22
,, ,,	Total abstainer, food normal	,, ,,	Dyspnœa marked on exertion, and at night often slept in wet clothes .. Sample 5	23
Face and legs ..	Drinks little beer, food normal	Slight cloud	Dyspnœa slight; not exposed more than usual .. Sample 3	24

LIST OF CASES OF NEPHRITIS OCCURRING IN THE

No. of case	Regimental No.	Rank and name	Age	Months in France	Date of illness	First symptom	Temperature on admittance	Date of admission
25	12335	Pte. G. M. ..	23	6	6.8.15	Dyspnœa and pains back and head	99°	7.8.15
26	24306	Drvr. A. S. ..	27	12	8.8.15	Giddy and vomiting, dyspnœa, rigor	100°	8.8.15
27	11175	Pte. R. W. ..	19	8	8.8.15	Giddy and vomiting	104°	9.8.15
28	6664	Pte. A. O. ..	40	12	10.8.15	Giddy and vomiting, and rigor	102°	11.8.15
29	9100	Pte. R. E. ..	26	4	10.8.15	Dyspnœa, rigor, giddy and weak	102°	11.8.15
30	1824	Pte. B. B. ..	20	5	9.8.15	Giddy	102°	13.8.15
31	2402	Pte. L. S. ..	25	5	12.8.15	Rigor, general pains	100°	13.8.15
32	2922	Pte. S. M. ..	22	5	12.8.15	Diarrhœa and sudden flushing of face	100°	13.8.15
33	12027	Pte. J. C. ..	29	4	25.7.15	Abdominal pain..	99°	11.8.15
34	10128	Gr. R. H. ..	36	11	9.8.15	Giddy; vomiting, pains in back	102·7°	16.8.15
35	40069	Pte. J. R. ..	20	11	13.8.15	Headache and feverish	102°	16.8.15
36	977	Drvr. A. N. ..	40	10	11.8.15	Headache; pains in legs	101°	17.8.15
37	11131	Pte. F. J. ..	21	3	18.8.15	Bloody urine, slight rigor; headache	101·2°	19.8.15
38	2906	Sjt. J. K. ..	25	11	15.8.15	Dyspnœa; hot and weak	102°	20.8.15
39	678	Drvr. L. T. ..	35	1	18.8.15	Dropsy of face ..	N.	20.8.15

FIRST DIVISION, FROM JULY 18, 1915.—*Continued.*

Dropsy	Habits as regards food and drink	Amount of albumin in urine	Remarks as regards cause, etc.	No. of case
None	Drank little beer, food normal and tinned stuff	Blood, slight cloud	Excessive sweating and cooling of clothes .. .. Sample 7	25
,, ...	Moderate beer, food normal	Slight cloud	Excessive sweating and cooling of clothes .. .. Sample 6	26
,, ...	Total abstainer ..	,, ,,	Excessive sweating; drunk water as tea only; water tasted funny at Givenchy a month ago .. .. Sample 8	27
Face slight ..	Total abstainer for ten years, food normal	,, ,,	Excessive sweating and used to shiver after it; noticed his urine "black" when taken ill; some vesical tenesmus .. .. .. Sample 9	28
,, ..	Total abstainer, food normal	Moderate cloud	Excessive sweating; had paratyphoid in January, 1915 .. .. .. Sample 10	29
Face and legs ..	Total abstainer, food normal	Slight blood and albumin	Sweats very heavily; had kidney trouble at Brighton in February, 1915 — All got wet the same day, just before illness and slept in their wet clothes — Sample 12	30
None	Drinks beer when he can get it, food normal	Much blood	Does not sweat — Sample 14	31
,, ...	Moderate beer-drinker, food normal	Slight cloud	Sweats heavily and chills after; water from pump — Sample 13	32
Face	Moderate beer-drinker; food normal	Heavy cloud	Sweats heavily, but not chilled after .. .. Sample 11	33
Face and legs..	A little beer, water from pump; food normal	Light cloud..	Very hard at work for a month, in dug-out, always hot and sweating, then cold at night. Operation for appendicitis two years ago	34
None	Lifelong abstinence; food normal	,, ,,	Very hot and sweating going up to trenches on a hot day and then had to sleep on a concrete floor	35
Face	Water from cart, no taste; abstainer for one month; food normal. Water from cask tasted of lime	Heavy cloud	Has been in a damp wood for a month, with wet ditches all around	36
None	Life abstainer; food normal	Full of blood	Was a cook. Slept on floor in a draught from a door that would not shut, and for three nights was very starved	37
,, ...	Drank well water, little beer; from water-cart always	Blood(?) moderate cloud	Was employed wiring in front of line; used to work hard; then the enemy would open fire, and would have to lie in wet grass for as much as three-quarters of an hour before commencing again, and soon would get very chilled; this he did for three nights before going sick	38
Face, legs, arms	Drank beer; water from well	Urine solid on boiling	Was dispatch rider for Headquarters. Got wet through and slept in wet clothes in an old barn on earth floor with no blanket, and was very chilled three days before ill	39

LIST OF CASES OF NEPHRITIS OCCURRING IN THE

No. of case	Regimental No.	Rank and name	Age	Months in France	Date of illness	First symptom	Temperature on admittance	Date of admission
40	7738	Pte. A. R. H. ..	20	9	18.8.15	Pains in head; giddiness	+ ? extent	20.8.15
41	22071	Pte. D. H. ..	24	6	16.8.15	Headache; nausea, dyspnœa	101°	21.8.15
42	12208	Pte. H. H. ..	34	9	7.8.15	Dyspnœa and insomnia	+ ?	20.8.15
43	18223	Cpl. D. H. ..	40	1	8.8.15	Dyspnœa; cough; vomiting; headache	102°	21.8.15
44	6567	Pte. A. J. P. ..	34	1	8.8.15	Dropsy of face ..	N.	21.8.15
45	14735	Cpl. T. M. ..	28	9	10.8.15	Vomiting; giddy..	103°	21.8.15
46	26992	Pte. W. B. ..	34	11	12.8.15	Rigor; giddy ..	+ ?	24.8.15
47	8069	Pte. A. D. ..	27	4	19.8.15	,, ,, ..	102·4°	25.8.15
48	10131	Rifleman R. W. C.	33	3	6.8.15	Dyspnœa and heartburn	(?)	26.8.15
49	11711	Rifleman W. P.	27	12	23.8.15	Abdominal pain; nausea; dyspnœa	102°	28.8.15
50	3384	Lance-Cpl. F. J. P.	31	11	25.8.15	Abdominal pain; rigor; nausea and headache	N.	31.8.15

EXAMPLES OF CASES

No. of case	Regimental No.	Rank and name	Age	Months in France	Date of illness	First symptom	Temperature on admittance	Date of admission
1	12381	Pte. G. E. A. ..	20	7	20.8.15	Headache and rigor; general malaise	102°	21.8.15
2	7629	Lance-Cpl. A. G.	23	6	18.8.15	Pains in back; rigor; headache	99°	22.8.15
3	11775	Pte. F. M. ..	38	4	20.8.15	Slight rigor; pains in back and legs; headache	101°	23.8.15
4	22046	Pte. J. E. ..	34	3	19.8.15	Pains in head and back, and rigor	(?)	25.8.15
5	1670	Cpl. J. S. ..	22	11½	24.8.15	Pains in legs and back; rigor	99°	26.8.15
6	6911	Pte. P. F. ..	32	12	27.8.15	Pains in legs and back; giddy and retching	+ ?	29.8.15

Dropsy	Habits as regards food and drink	Amount of albumin in urine	Remarks as regards cause, etc.	No. of case
None	Drank beer; water from cart	Slight blood	Often wet through with rain and with sweating, and slept in wet clothes on earth floor without blanket	40
,, ...	Little beer; water from cart	Moderate cloud	Always comfortable in billet	41
,, ...	Drank red wine, water from pump	Heavy trace..	Cook; often very hot and sweating; had no blanket, and had to lie on asphalt floor	42
,, ...	Little beer; water from pump; food normal	Moderate ..	? Enteric. Blood in motion, lived in draughty billet, and sweated hard and chilled after it. Had bronchitis in March	43
Face, legs, arms, scrotum	Moderate beer; water from pump; food normal	Heavy cloud	Transport worker; always warm and dry, and never mosquito-bitten	44
None	Drank beer; water from pump	Slight cloud	Comfortable and dry in billet	45
,, ...	Drank beer; but never water; food normal	Blood and heavy cloud	Comfortable, never wet, much mosquito-bitten	46
,, ...	Little beer; water from cart; food normal	Blood, moderate albumin	When going on duty was hot and sweating, then got wet through as he stood in the trench, shivered and went sick the same night	47
Face, legs and arms	Little beer; water from cart; food normal	Heavy cloud	Was gradually becoming ill with nocturnal dyspnœa, when he got wet through and slept in wet dug-out; began with dropsy soon after; rigor August 25, 1915; kidneys swollen and tender	48
Face, legs and arms	Little beer; water from pump, but mostly drank tea; food normal	,, ,,	In bivouac last two months; comfortable and dry; began with a cold in his head that suddenly developed into nephritis. Very bad smells where he was	49
Face, legs and arms	Drinks beer; water from cart, but always as tea	,, ,,	Marked dyspnœa two days after attack; kidneys tender; sweats heavily on least exertion; always a night worker with transport to trenches; not mosquito-bitten	50
OF ALBUMINURIA REJECTED.				
None	Drank little beer; water from pump; food normal	Trace ..	Was sapping in a tunnel in front of first line of trenches immediately before being taken ill. *No dyspnœa*	1
,, ...	Drank little beer; water from pump and cart; food normal	,, ..	Draughty billet, but has not been abnormally wet. *No dyspnœa*	2
,, ...	Drank beer and water from cart; food normal	,, ..	*No dyspnœa.* Was three days in trenches immediately before being taken ill	3
,, ...	Drank little beer; food normal	,, ..	*No dyspnœa.* Billet very draughty; has not been abnormally wet	4
,, ...	Very little beer; water from pump; food normal	No albumin on first admittance; trace on second admittance	*No dyspnœa.* Slept on stone floor in draughty billet; wet through August 16, 1915; was sent to convalescent camp, but was returned from C Company September 1, 1915; faint trace of albumin, which vanished next day	5
,, (?)	Moderate beer; water from cart	Heavy trace	*No dyspnœa.* Digging in trenches two nights before ill, sweated heavily, then returned to lie down in cold billet at 2 a.m.; often shivered with cold	6

Alexandria Clinical Society.

The inaugural meeting of the Alexandria Clinical Society was held on December 1, 1915, in the 21st General Hospital. Lieutenant-Colonel Robinson was in the chair, and over one hundred members attended.

There was a preliminary exhibition of blood parasites by Major Fergusson, pathological specimens by Lieutenant Bartlett, and various extension splints by Lieutenants Moore and Blake.

Captain Blacker described a case of jaundice occurring in the later stages of paratyphoid fever B. Intractable vomiting supervened, followed by profuse intestinal hæmorrhage, from which the patient died. Post mortem, healed ulcers were found in the small intestine and two small recent ulcers in the colon, from one of which the hæmorrhage had occurred. These were demonstrated. Degeneration had occurred in other organs, and there was an enlargement of the mesenteric glands and spleen. No obstruction was discovered in the bile-ducts, but the paratyphoid bacillus B was grown in pure culture from the gall-bladder.

Captain Wareham described a case of multiple injuries produced by a single shrapnel bullet. The bullet pierced the left pleura, spleen, left kidney and vertebral column, cutting across the spinal cord. The patient died, and the various organs injured were shown at the meeting.

Captain Whitaker showed two cases of severe infected gunshot wounds of the head which had been treated by free opening up of the wounds, removal of bone from the vault, etc. The two patients, who were making a good recovery, were brought into the meeting.

Colonel Robinson remarked that Captain Whitaker had now treated ninety-four cases of head injury with a mortality of 15 per cent. In fifty-four cases the brain had been wounded.

Lieutenant Buchanan described a case of fracture dislocation of the spine at the third lumbar vertebra due to a shell explosion, which caused complete paraplegia and loss of sensation in both legs. The patient suffered simultaneously from a Pott's fracture of the left ankle, from dysentery and paratyphoid B. Both femurs were transfixed with pins, and twenty-five pounds extension applied to each, the pelvis being placed on a trolley and the bed inclined head downwards at an angle of 30°. X-rays were shown illustrating the spinal injuries and deformity before and after extension. The patient, who was greatly improved and had recovered the power of moving his legs, was brought into the meeting.

A discussion on gunshot fractures of the femur was opened by Captain Hey Groves. He began by giving a summary of 60 consecutive cases, which had occurred sufficiently long ago for the results to be known. Of these 6 cases died (2 from dysentery) and 4 suffered amputation.

Of the remaining 50, 37 recovered with a good limb in every respect. In 2 there was some deformity, 8 had delayed union, and 3 persistent sinuses. He laid great emphasis on the importance of early immobilization in a wire cradle splint, the leg being kept with semiflexed joints, so that dressing could be frequently done without movement. When the patient is admitted to hospital weight extension is applied, usually attached by means of a transfixion pin. The advantages of this method consist in the fact that, provided sepsis has been overcome, a certain restitution of form and function can be guaranteed. Hè admitted that in some cases sepsis arose in connexion with the transfixion holes, but held that if due precautions were observed this could be reduced to a negligible quantity. In briefly reviewing other methods, the speaker condemned straight wooden splints and open operative measures. He held that the Thomas knee splint was open to criticism on account of the discomfort produced by the ring round the thigh, and that whilst both the Balkan and Hodgen splint were correct in principle, they were liable to practical objections, which were overcome by the wire cradle splint. These and other splints demonstrated at the meeting were being made locally and supplied to various other hospitals and ships.

Captain P. M. Heath (No. 15 General Hospital) spoke next. He said he had not yet been able to prepare statistics, but his impression was that their numbers were considerably larger than those described by Captain Hey Groves. Many of their cases had been septic and many had been treated by amputation. Various methods of treatment had been tried, including extension with a long Liston splint, Hodgen's splint and the Balkan splint. He found Hodgen's splint unsatisfactory owing to the leg swinging. In using a Balkan splint, he thought the slings should be short to avoid swinging and the splint should be applied obliquely in the bed to bring the lower fragment into line with the abducted upper fragment. To avoid sagging of the thigh when the main sling was removed for dressing he applied several small separate slings and Gouche splinting under the main sling. He had treated several cases by transfixion and many of them showed a mild degree of sepsis around their pin. He described a case with splitting of the condyles which has been successfully treated with the horseshoe clamp demonstrated by Captain Hey Groves. As to complications, he had had one case of large round-celled sarcoma arising in an amputation stump Another case had vomited everything persistently, until treated lying on his face, after which he recovered.

Major Choyce (No. 19 General Hospital) said that he thought direct plating was sometimes justified but the indications for it were rare. He had treated a few cases in this way with success. He agreed with Captain Hey Groves that the more the comminution the better the alignment obtained. Very few of their cases had been clean. In treating

by transfixion he thought [there was danger of introducing sepsis in removing the bit. This might be overcome by making the bit in two pieces like the ramrod of a shot gun. With Captain Hey Groves's splint he thought there was danger in septic cases of the pus tracking up the thigh owing to the elevated position of the knee.

Captain A. W. Bourne (No. 17 General Hospital) described the results of treating 35 consecutive cases in which the following results had been obtained: Mortality, 21 per cent; amputation, 14 per cent; union of fracture, 60 per cent. Of these 11 had been clean cases and all gave union with less than one inch shortening. Fifteen cases had septic wounds, with 60 per cent of good results. Of the remaining 9, where infection was still more severe 62 per cent died. Amputation was done in 25 per cent; and union of fracture did not occur in any. In two cases direct operative fixation by wire was performed. Both of these died. Of the remainder an approximately equal number were treated by strapping extension, Hodgen's splint and transfixion extension with 62, 75, 77 per cent good results respectively. Captain Bourne considered that in certain cases immediate operative fixation was admissible, provided that there was an absence of comminution, easy accessibility of the fragments and great deformity, not amenable to other treatment. He spoke well of transfixion extension, but pointed out that ulceration often occurred round the entry wound of the pin.

Colonel Tubby said Captain Hey Groves's splints were an advance on older forms, the fact that they were self-contained being a great advantage over other splints with extension. He agreed that in the past insufficient weight extension had been recommended and he would have no hesitation in using up to thirty pounds. The weight should be all put on at once and not in driblets which caused fresh contractions of the muscles. Counter-extension could best be applied to the sound limb. The chief criticism of Captain Hey Groves's methods had been the discussion of the limits of usefulness of transfixing the femur owing to the risk of sepsis. Time would show whether this method would become generally recognized. He congratulated Captain Hey Groves on his phenomenal results.

Captain Hey Grooves replied to the discussion.

Colonel Tubby said it was proposed to hold another meeting in a month's time. Details had not been arranged but would be announced later.

Clinical and other Notes.

SOME NOTES ON A CASE OF MIXED INFECTION OF THE ENTERIC GROUP TREATED BY VACCINES.

By Lieutenant E. L. HORSBURGH, R.A.M.C.

The interest of this case lies in the fact that it would appear probable that no fewer than three distinct infections occurred throughout the illness.

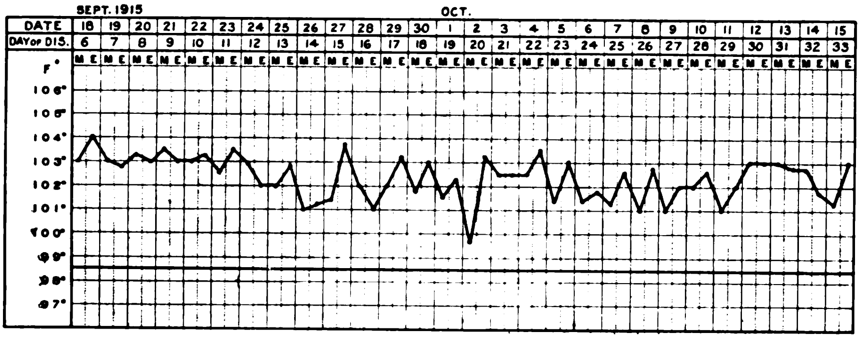
The patient was Private T. L., attached to the Field Ambulance, R.A.M.C.(T.F.). He was admitted to hospital by convoy from the Front with a history of acute illness extending over ten days. The symptoms of which he complained were anorexia, headache, especially in the occipital region, and general abdominal pain. There was no history of epistaxis or diarrhœa. The condition on admission was as follows: Temperature 103° F.; pulse, 72; dicrotic; tongue clean and moist. There was a typical rose-coloured eruption on the chest and abdomen. The abdomen was tense and distended. The spleen was not palpable, but generally enlarged to percussion. The lungs and heart were normal.

Blood culture taken at hospital on the eleventh day of illness was negative, but a report followed the patient from the clearing station at the Front reporting that *Bacillus paratyphosus* B had been isolated from the blood.

A Widal reaction taken on the twelfth day of disease showed agglutination to *B. typhosus* in a dilution of 1 in 20, which was in keeping with the fact that the patient had been twice inoculated against typhoid, but there was no agglutination to either of the paratyphoid group, even in so small a dilution as 1 in 4.

The fæces were plated out on Fawcus's modification of Conradi's brilliant green medium, which has always given, in my hands, the best results in plating fæces. Many non-lactose-fermenting colonies, which were Gram-negative and motile in broth, were recovered from the stools, and the following reactions were given by this organism: Acid and gas in glucose broth; acid and gas in mannite; no change in lactose; an acid reaction in litmus milk on the seventh day; no indol production in peptone water. Tests with known agglutinating sera showed complete agglutination of the organism with paratyphosus A serum, and no agglutination with either paratyphosus B or *B. typhosus*.

Having regard to the fact that paratyphosus B had been isolated from the blood, all reactions were repeated with similar results. The suggestion was, therefore, that the patient was suffering from a double infection of paratyphoid A and B. The Widal reaction was repeated after a week's interval, but again no agglutination was obtained beyond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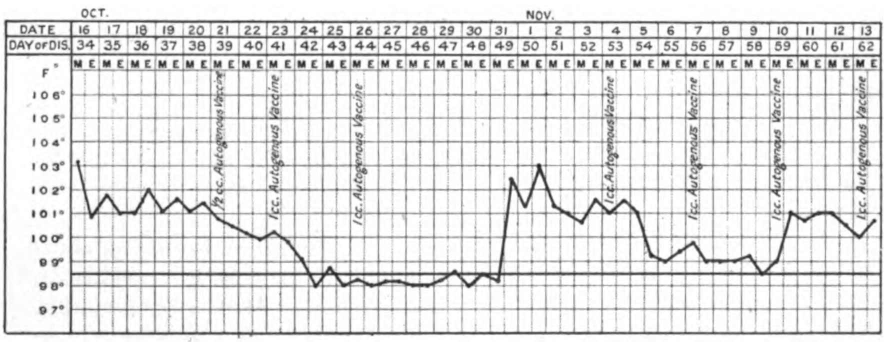
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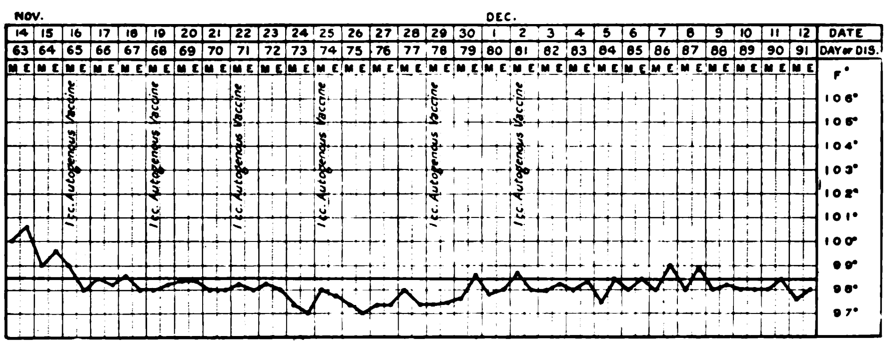
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the original 1 in 20 with *B. typhosus*. In both tests Dryer's macroscopic method was used.

The patient continued to be acutely ill, and on the twenty-fifth day of the disease he had a small hæmorrhage from the bowel. This was followed by a passage of sloughs and shreds of mucus, and the stools, from being atypical of typhoid, became very loose and offensive.

This change in the character of the stools led to a further bacteriological examination of them being made. Many non-lactose-fermenting colonies were again obtained, which consisted of Gram-negative bacilli, non-motile in broth, and with which the following reactions were obtained: Acid without gas in glucose broth; no change in lactose or mannite; litmus milk was turned first acid, then alkaline without clotting of the medium, and no indol was produced in peptone water.

Agglutination tests against the various agglutinating sera of the dysentery group showed complete and instantaneous agglutination with *Bacillus Shiga-Kruse*. The series of experiments was repeated with similar results. Up to this point no fewer than three distinct organisms had been isolated from the patient:—

B. paratyphosus B from the blood in the first week of the illness;

B. paratyphosus A from the stools on the nineteenth day of illness;

B. Shiga-Kruse from the stools on the thirty-seventh day of the illness.

As the patient's temperature had been incessantly up to between 101° and 103° F. for nearly six weeks and showed no signs of abating, and as the patient's condition was reported as critical, it was decided to try the effect of a mixed vaccine.

Accordingly a vaccine was prepared from a stock paratyphosus B (the original one not being available) and from the patient's own paratyphosus A, and also his own Shiga. The vaccine was prepared to contain 50 million of paratyphosus A and B respectively, and 100 millions of Shiga-Kruse to the cubic centimetre. Such experience as one has had with vaccines of this group of organisms has suggested that the dosage to be effective must be high, and the vaccine was prepared in accordance with this experience. Half a cubic centimetre was given on the thirty-ninth day of disease and one cubic centimetre on the forty-first.

Towards the sixth week of the illness the patient became very noisy and restless, and wandered almost incessantly; and after each dose of vaccine the mental condition appeared to be aggravated.

After the second dose of vaccine, however, the temperature fell to normal for the first time during the illness, and the patient's condition was reported as considerably improved. Another dose of vaccine was given three days after the second dose, and examination of the stools three days after this was negative for pathogenic organisms. Unfortunately, owing to a misunderstanding, the vaccine was at this stage discontinued, and five days after its discontinuance the patient had a sharp relapse with a temperature 102·8° F., and loose offensive motions again. The stools were

plated on the third day of the relapse, and *B. Shiga-Kruse* was isolated again. At this time the patient was noisy and restless, with passing fancies and delusions, and very excited at night. He had also marked incontinence of urine in which there was much mucus, but bacteriological examination was negative for pathogenic organisms of the typhoid-dysentery group.

The vaccine was started again on the fourth day of the relapse, and repeated at three-day intervals. The temperature began to fall again at once, reaching normal five days later, and though it rose again to 101° F. for two days it gradually subsided, together with marked improvement in the general condition of the patient.

On the sixty-fifth day of disease the temperature reached normal and remained so. All the symptoms gradually cleared up, and the patient was evacuated to England by convoy, walking well and apparently cured. The stools were examined before his discharge and were found free of pathogenic organisms.

In the initial stages of the relapse the urine was examined by Captain McKee, of No. 2 Canadian General Hospital, with regard to its hæmolytic action of human red blood corpuscles. The urine was found to be strongly acid and hæmolysed at once, but thirty-grain doses of bicarbonate of soda entirely abolished this hæmolytic property in forty-eight hours, and on this account Captain McKee gave a favourable prognosis.

The case would appear to be one in which a mixed vaccine undoubtedly influenced the disease profoundly. That the temperature should have begun to fall so soon after its administration is certainly suggestive, seeing that it never showed the slightest tendency to do so previous to the administration of the vaccine. The relapse, too, following closely on its discontinuance, in which *B. Shiga-Kruse* once more appeared in the stools, and the rapid disappearance of the organisms again on renewal of the vaccine, coupled with the rapid improvement and subsequent recovery of the patient, point very clearly, I think, to the vaccine as the curative agent in the disease.

The case suggests, too, that bacilli of the dysentery group might be present in other cases of a similar type, and it certainly indicates that vaccines, essentially autogenous vaccines, in certain cases are capable of allaying the very chronic nature of the diseases caused by the members of the typhoid, paratyphoid, and dysentery group of organisms, whether present as a single or a mixed infection.

With regard to the reaction produced by the vaccine there was never any local reaction, but each dose of vaccine was followed very rapidly by a marked general reaction in which the patient's symptoms, especially the mental symptoms, became greatly aggravated, but such aggravation was very transient and was succeeded by a general amelioration.

Later on, as the patient recovered, the injections were followed by

a very slight general reaction only, and during convalescence there was no reaction at all.

This case, in my experience, is unique, inasmuch as both paratyphoid organisms and one of the dysentery group were isolated at different stages of the disease, but the results of the vaccine treatment would lead one to suppose that we need be no more alarmed at a mixed infection than at a single one.

The temperature charts afford a very telling proof of the results claimed in the manuscript.

NOTES ON THE TREATMENT OF COMPOUND FRACTURE OF THE HUMERUS.

By Captain E. M. COWELL
Royal Army Medical Corps (S.R.)

From the military point of view, time spent in treating the less serious wounds, and thereby accelerating patients' recovery, enabling them to return to the ranks at the earliest possible date, is of extreme importance. In this class may be considered the slighter cases of compound fracture of the humerus.

The important surgical principles of early removal of dead tissue and fragments of infective material, together with the establishment of effective drainage, will be admitted at once by all surgeons who have had experience of gunshot wounds of the long bones.

In many cases of compound fracture of the shaft of the humerus due to gunshot wounds, the most extensive damage to bone and soft tissues may be found with small or even insignificant wounds of entry and exit. There is often a tendency on the part of medical officers to treat such cases merely with superficial antisepsis and changes of dressings, instead of submitting them to surgical interference. In this way sepsis steadily develops, and the patient may remain several days before reaching the hands of the operating surgeon.

Provided the situation permits, and granted a sufficiency of time, each case of compound fracture of the humerus should be taken to the operating theatre and examined under an anæsthetic.

In the bulk of the cases the wounds of exit and entry require excision —dead muscle and connective tissue should be snipped away, and all fragments of clothes and soil removed. The wound is then explored with the finger, and the amount of damage to the tissues estimated. Blood and clot is removed as thoroughly as possible in order to diminish the risks of infection. In cases where there is reason to suspect damage to the large vessels the wound should be opened up and a careful inspection made. On several occasions I have seen the retracted ends of a torn brachial

artery lying free, merely plugged by a loose clot. After irrigation with some antiseptic lotion, a large-bore drainage-tube is placed in a suitable position to secure both through-and-through irrigation and drainage, and stitched at both ends to the skin.

The large-bore tube, with well-cut fenestræ, presents in these cases the following advantages over other forms of drains, and especially those of the "gutter" type recently advocated:—

(1) A profuse discharge is found to escape on to the dressings.
(2) Irrigation is easy and effective.
(3) Wright's tablets may be introduced into the wound.
(4) Air is conducted into the interior of the wound.

In some cases of early or threatening gangrene oxygen has been allowed to run into the tube, with the best results.

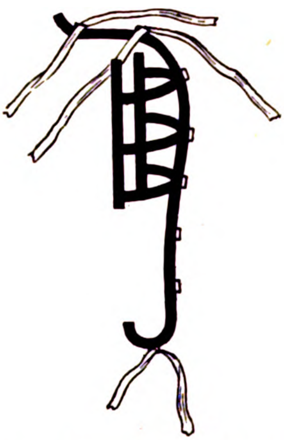


FIG. 1.—Aluminium "basket" splint for fractures of upper part of the humerus, showing shoulder tapes and extension bar.

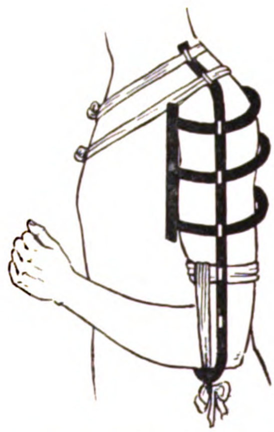


FIG. 2.—Ditto, applied.

After the application of dressings I find a light aluminium "basket" splint the most comfortable for the patient. This allows him to walk about with ease, and travel as a sitting case in comfort. The splint is simple, and allows the dressings to be changed without its removal.

A glance at fig. 1 shows the method of construction of the splint, the materials for which are taken from the Field Fracture Box. Only a few minutes are required for the fashioning of the splints, and an orderly can make them from a pattern. A bar of aluminium, two feet long, is bent to follow the curve of the shoulder, and continued beneath the elbow to form an extension bar. Two short straight pieces nine inches long are connected by cross pieces of metal tape twelve inches long passed through the staples on the long vertical bar. The number and exact position of these cross pieces may be varied to suit individual cases. The splint is

now ready to be applied to either arm. Two tapes, passing through the first two staples on the bar and tied under the opposite axilla, serve to keep the shoulder curve in place. Extension of the lower fragment is effected by tapes, attached to a circular band, tied under the extension bar. The forearm is supported by a sling, and lies across the chest as shown in fig. 2.

In conclusion, I wish to point out again the ease with which the splint may be obtained, and the comfort given to the patient. My excuse for describing this splint is that, having failed to make these patients comfortable by any other splint at present in vogue, it has seemed worth while to induce other surgeons to make use of the "basket" splint.

Note by Colonel Cuthbert Wallace.—I have seen several cases treated by this splint. It is easy to apply, efficient and comfortable.

RADIOGRAPHY IN GUNSHOT WOUNDS OF THE SKULL.

By Captain GEO. VILVANDRÉ.
Royal Army Medical Corps.

Head wounds in which the cranium is involved may be divided into two classes: those in which the foreign body penetrates the skull and *lodges* in the brain, and those in which the foreign body damages only the outer or inner table, but either glances off the bone or perforates the skull from side to side, the outlook being darkened in proportion to the damage done by the missile in its track.

From the many cases one has seen, the prognosis must be worse when the foreign body lodges in the brain. Firstly, because of the sepsis entailed and its sequela of deep-seated abscess; secondly, because of the irritating presence of the missile; and thirdly, because of the trauma necessarily caused by the surgeon in his search for its removal, besides the primary disintegration of nerve cells and fibres in its path.

The undertaking of the operation of trephining should not be lightly done, and only the experienced surgeon has a right to do so. Much more care and skill are required when opening of the dura is necessary, and here I would emphasize the point that when within reach of an X-ray apparatus and competent radiographer, no operation should take place on a skull which has not been previously radiographed to ascertain the presence or absence of a foreign body, and its careful localization.

To trephine a skull for a depressed fracture the clinical signs of which are obvious or even urgent, without first ascertaining the presence or absence of a missile (again where the case is within reasonable reach of the X-rays), does not seem to be rational. The relief of decompression may be sought and had within a few hours; but if the patient still has a bullet or a piece of shrapnel in his brain, is the future prognosis really

improved? I think not, and even if it were, I maintain that the patient should be radiographed first, so as to avoid a second operation.

We must all recognize the seriousness of trephining in war surgery. To my mind it is often like opening the portals of death. Therefore to have to reopen a skull for the removal of the missile is courting death a second time.

We must all come to the conclusion that in all cases—with perhaps a few remote exceptions—a patient with a bullet or shrapnel in his brain will die of cerebral abscess within six months. This teaching is certainly most emphatic on this side of the Channel, and I have it on eminent authority. The only exception which might be allowed is that in which the bullet is not distorted through a previous ricochet, and in all probability aseptic. The first point may be ascertained by X-rays. Who will swear to the second? Further, owing to the softness of brain matter (especially when damaged), bullets, because of their weight, have a tendency to gravitate, and their path must mean further damage.

Since writing the above the following case arrived. This patient was previously trephined at a field hospital before admission to hospital, where he was X-rayed and found to have a trephined hole in the frontal bone, a linear crack posterior to the petrous bone, and a depressed fracture with shrapnel and bony fragments. These were located at a depth of one and a half inches, and removed by Lieutenant T. Twistington Higgins.

Whilst fully convinced of the importance of radiography previous to operation in skull cases, one must not forget that even a good skiagram may be negative when the clinical symptoms point to the presence of a depressed fracture, which may be small or at the base. This apparent failure of the X-rays is still more obvious in the presence of a small linear crack or fissure, although I have often been able to show this. Although the small fracture may escape detection radiographically, the presence or absence of a foreign body will always be determined, and the clinical signs should outweigh a negative skiagram in the guidance of the surgeon.

Furthermore, as a rule the damage to the skull is more extensive than shown on the skiagram; this being probably due to the incidence of the rays on a round body. A straight pencil of rays will tend to convert a cylindrical object into an elliptical image, if striking that cylindrical laterally, and the ellipse will vary with the angle of incidence.

I may, in what follows, be jumping to too early conclusions, but I have been forcibly impressed in the operating theatre, and in the wards, following many head cases previously radiographed, by the fact that skulls with long comminuted fractures and *no* foreign body being present, skulls in which even depression was great, seemed to do well. Such a case is that of Captain Nash-Wortham's, which I have asked him to publish. To put it briefly: in spite of the great damage done to the vault, the extensive comminution, the depression of the

fragments and ablation of bone, this man did well, and went home ot England, smoking and happy.

Another is that of Mr. T. T. Higgins's, which in spite of a depressed comminuted fracture and a long crack extending some two-thirds of the length of the vault, did well.

I know of several others, and have been impressed by the connection of extensive fracture and good recovery. Thinking over the matter, does this point to the fact that long fractures are more efficient in relieving pressure than localized small trephining of one inch or so in diameter? Is a widespread decompression of a certain degree more efficient than decompression of a greater degree in a smaller area? Some surgeons, of course, remove a large piece of the vault where others would be satisfied in making a small trephine hole, but in the first case the bone is removed over the large area decompressed.

In the cases I am thinking of, the bone remains in situ, being only lifted through intracranial pressure. The natural juxtaposition of the bone to the dura, and of the latter to the grey matter, persists to a great extent, and this must lead to success. It must tend to prevent hernia cerebri and its sequelæ of brain destruction and sepsis. The blood supply of the parts must remain nearly normal.

One wonders whether the lifting of a large area of bone and its replacing after the necessary cleaning of clot, and removal of loose bodies, whether metallic or bony, are not to be preferred to the ordinary trephining and removal of bone by rongeur. In the case first mentioned the best part of the fronto-parietal skull could be lifted up at will. One must think of future callus entailing further compression: but do not many fractured skulls do well, and go through life without further symptoms, except some slight headache—skulls untouched by the surgeon?

May I add that in most skull cases where localization was necessary we found that two plates giving respectively a lateral and an antero-posterior view were always satisfactory. But careful measurement should be taken. The rounding of the cranium may otherwise lead one into error, as I was myself in a case where the small piece of shrapnel which appeared to be lodged well into the frontal lobe was in reality lying on the bone.

A CASE OF HYPERACUTE CEREBROSPINAL MENINGITIS WITH ABSENCE OF CEREBRAL SYMPTOMS: MENINGOCOCCUS ISOLATED FROM THE BLOOD.

By Captain H. H. SCOTT.
Royal Army Medical Corps.

Private F. A. E., Bramshot Camp. So far as could be ascertained the patient had been in his normal state of health until 7 p.m., December 15, 1915, when he had a rigor, and his temperature rose to 104° F. He made no definite complaints then, and nothing particular was noticed during the night. The temperature during the 16th fell gradually to 102° F.

The patient was seen by Captain Alex. Lundie, R.A.M.C., and myself, accompanied by Lieutenant Keiller, who was in charge of the ward to which the patient had been admitted. Our visit was made at 4 p.m. The patient was perfectly rational and clear mentally, stating that he felt no headache, and little if any pain while lying quietly in bed.

There was marked congestion of the skin generally, with a mottled, purpura-like rash, which paled and in some parts disappeared on pressure; it was not raised. The limbs were somewhat more extensively affected than the trunk, and the face was almost exempt. The size of the spots varied from that of a pin's head to 1·5 to 2 centimetres in diameter. There was intense hyperæsthesia of the lower limbs and of the trunk below the level of the superior iliac spines, so that considerable pain was caused by testing for Kernig's sign and ankle clonus. Kernig's sign was present in both limbs, but a little more marked in the left. Both knee-jerks were exaggerated. Clonus was not obtained, but attempts to elicit this symptom were not persisted in owing to the pain caused thereby.

The patient was moved to the isolation hospital the same evening, arriving between 7 and 8 p.m. He was quite rational and spoke to the Chaplain within ten minutes of death, which took place at 8.10 p.m. There was no vomiting and no complaint of headache throughout, no convulsions, and no delirium.

Autopsy. 11 *a.m., December* 17, *by Lieutenant Cooke, R.A.M.C.*—The body generally was plum-coloured from cutaneous hæmorrhage, and the ears were nearly black.

Brain and Meninges.—Meninges congested, but not markedly. The arachnoid showed small flakes of lymph with points about the size of a split pea where there was pus in an early state of formation. These were most extensive over the parietal convolutions on the left side, and extending down to the hippocampus. The surface generally appeared odematous and boggy, and there was dulling of the membrane over the interpeduncular space and the inferior surface of the cerebellum. On

section the cerebral tissue was congested, and small injected puncta were visible. The choroid plexuses were both intensely congested. There was no obvious excess of fluid in the ventricles and no pus.

Spinal Cord.—Marked congestion of the vessels of the dura and of the cord itself, with a few small flakes of lymph, some of them becoming purulent, especially over the lower half of the cord.

Thorax.—Congestion of moderate degree of the base of the left *lung*, and some puckering of both apices; nothing else abnormal noted in these organs. The bronchial glands at the root were enlarged and hyperæmic.

Heart.—Numerous petechiæ and some small ecchymoses over the posterior aspect of the heart (visceral pericardium and superficial myocardium), more marked over the left ventricle and at thea uriculo-ventricular junction.

Abdomen.—Spleen dark, not enlarged. Liver congested but otherwise apparently normal. Pancreas showed some congestion and minute petechiæ on section. Adrenals markedly congested, the left being almost hæmorrhagic.

Cultures.—Fluid from spinal theca obtained post mortem. (Patient died too soon after admission for this to be taken during life.) Slightly turbid with small blood-stained deposit. Smears of this show abundant diplococci, mostly intracellular, many leucocytes being packed with them; there are, however, several extracellular diplococci seen. Fluid plated on serum-nasgar. Blood taken from right ventricle dark in colour. Placed in serum (ascitic fluid) broth (1 : 9) for cultivation. Culture: Meningococcus present in pure culture in spinal fluid *and in the heart blood.*

Remarks.—Apart from the rapid course (death occurring in twenty-five hours after the onset of symptoms) this case is of exceptional interest for the following reasons :—

(1) The absence of cerebral symptoms. The patient made no complaint of headache at any time during the illness, and repeatedly affirmed that he felt no pain in the head at all. There was never any vomiting, nor any convulsions, delirium, or loss of consciousness till death.

(2) His mental faculties were quiet clear and unimpaired. He spoke quite rationally, and conversed with the Chaplain to within ten minutes of death.

(3) The peculiar limitation of hyperæsthesia. This was intense in both legs and the lowest part of the abdomen. Any movement of the lower limbs appeared to produce agonizing pain, while that of the upper limbs and head was apparently free and painless. It will be noticed that the inflammation of the spinal meninges was more marked over the lower part of the cord post mortem.

(4) The crowding of the leucocytes in the spinal fluid with meningococci. Very few were devoid of them, and many contained thirty, forty, and even more diplococci.

(5) The temperature, which in hyperacute cases is usually high, did not rise above 102° F. after the initial rigor, when 104° F. was registered.

(6) The isolation of the meningococcus from the blood as well as from the cerebrospinal fluid.

THE CASE-RECORDING OF WOUNDS IN WAR.

By Lieutenant-Colonel A. W. SHEEN.
Royal Army Medical Corps (T.F.).

This is to be a very simple paper. It aims at suggesting a useful form in which records of cases of gunshot wounds can be compiled both for present and for future reference. Military hospitals provide a "Medical Case Sheet," A.F. I. 1237: this is blank except for identification headings; it has no free margin for subsequent fastenings of the sheets together. While sufficient for ordinary purposes, this sheet may, with advantage, be replaced by a special form with appropriate sub-headings designed for the record of wounds in the present War. For these wounds—unprecedented in number and in character—an easy, rapid and uniform method of case-recording is desirable.

My text shall be the case-sheet now in use at the Welsh Hospital, which is here reproduced. At the head of the sheet is put the name and locality of the hospital or medical station where the record is made. The next headings are those of the ordinary "medical case sheet" with additions. The "result" is "furlough," "auxiliary hospital," "invalided," "home duty," etc. The "home address" might also be called the "civilian address." It is the address at or from which the patient can always be reached. It has an immediate use in case the man is taken unexpectedly seriously ill, his name not then being on the danger list, and a later use in tracing the case and in finding the "end-result."

The "civil occupation"—and the bulk of our Army is now formed from those who have civil occupations—needs no comment; neither does the "single, married, widower," which the three capital letters signify: two of these are crossed out.

Passing to the sub-headings, the "diagnosis" should be definite. Not "gunshot wound"—a phrase which is often understood to mean rifle bullet wound only, whereas it means a wound from any missile which is shot from any gun—but shell, shrapnel, bullet, grenade, or bayonet wound, as the case may be. Also the important facts of the lesion should be brought out.

So not "gunshot wound of thigh," but "traversing bullet wound of right thigh; compound fracture of femur"; not "gunshot wound of chest," but "lodging shell wound of right chest: empyema." I prefer the term "lodging" to "penetrating," and "traversing" to "perforating."

"Penetrating" and "perforating" are liable to be confused. Such terms as "gutter wound," "subcutaneous channel wound," "double traversing wound," "explosive exit wound," are useful.

"The abstract of case" should very tersely express the leading facts. Thus the two specimen diagnoses given might have the following abstracts: "Marked sepsis, continuous eusol irrigation, suspension, extension from pin through tibia, union firm fourteen weeks after wound, discharged with sinus, one inch shortening," and "Empyema opened twelve days before admission, X-rays show shell fragments on eighth D.V., no tube and superficial granulating surface on discharge."

Very valuable is a definite space for the "diagram of wound." Stamped on or pasted in outlines may be used, but I prefer rough annotated outlines or sketches by the medical officer, on which the wounds are shown. It is easy after a little practice for those quite unskilled to make simple drawings. The roughest diagram is better than none at all. The part should be drawn in the position it occupied when the wound was received. A dotted line joins entrance and exit wounds. The outlines of organs can be drawn when necessary, or a bone with fracture shown. The diagram can also be used for indicating the site of an operation. An unoccupied portion of the space allotted may be used for the sketch of an X-ray picture. These diagrams will at once give an idea of the condition and save much written description.

The "nature of missile": The term "gunshot" should not be accepted from the patient, who usually means by it "rifle bullet"; neither should the term "explosive bullet," by which the patient means a bullet which has had an explosive effect. Machine gun bullets are similar to rifle bullets, and the patient cannot usually make a distinction. With regard to "shrapnel" and "shell," at one time shrapnel was discharged by a low explosive, so that the case did not burst, and shrapnel wounds were wounds produced by the round shrapnel balls, but now the case is charged with high explosive, a "bursting charge," which scatters it into fragments. Therefore, when the patient says he was wounded by "shrapnel," it may not nowadays mean shrapnel ball.

"Hand grenade," rifle grenade," "hand bomb," "shell from trench mortar," all mean missiles producing similar wounds. Colloquialisms such as "Jack Johnson" or "Whizz-bang," can be added, or the patient may be able to name definitely the source of the missile which wounded him.

The "estimated range" no doubt is often inaccurate. Many patients are reluctant to suggest any range at all, but it should be recorded wherever obtainable, for in a large series of cases error will be to a great extent eliminated and a correlation between range and extent of tissue damage observed. Recording of range is of course of value mainly with bullet wounds, for with shell the bursting of the charge gives to the fragments a new and increased velocity.

STATION OR HOSPITAL________________________ *Year*______

No. in Adn. and Disch. Book.	Regl. No.	Rank.	Surname.	Christian Name.	Age.	Service.
....	....	....	....	....	......	....

Unit.. Date of Adn............ Date of Disch............... Result..............

Ward..................................... Medical Officer...

Home Address.. Civil Occupation........................... S. M. W.

Diagnosis :

Abstract of Case :

Diagram of Wound :

Day and Hour of Wound ? Wounded at ?

Nature of Missile ? Estimated Range ? Direction ?

What doing, and position of body when wounded?

Consciousness lost ? For how long ?

Time and method of First Aid ?

How moved and how far ?

Dressing Stations, Hospitals, etc., in which treated? How long in and treatment in each?

Operation ? Nature and Date ?

Anti-tetanic Serum ? Date ?

Other points in History of Case ?

CONDITION ON ADMISSION.

Entrance Wound ?

Exit Wound ?

Missile Track (including length)

Account of Tissue Damage :

Pathological Report :

X-ray Report :

Other facts of Condition on Admission :

Progress and Treatment : Account of any Operation : Account of any Missile Removed :

Final Note on Discharge, with Date :

Signed
Name...................... Rank.............
Medical Officer.

MARGIN. NOT TO BE WRITTEN ON.

The "direction" means "front," "right flank," etc. Other sub-headings call for little comment. The "length of missile track" can be measured with a pair of obstetric callipers. The "account of tissue damage" will refer particularly to visceral, bone, vessel, or nerve injuries.

The pathological and X-ray reports arrive from the departments concerned on a special sheet. This sheet is so designed that if the report is lengthy the sheet can be fastened up with the notes; if short the report is copied in.

"Progress and Treatment": "Progress" connotes changes in the patient's general condition and in the wound; wound complications, such as hæmorrhage or cellulitis, results of changes in wound dressing; bacteriological changes in wound; results of further X-ray examinations; return of consciousness; temperature regaining normal; gain of weight; day of getting up; return of motion and sensation; increasing ability to use the injured part; union of fracture; and so on. Under "treatment" are recorded the dressings and lotions used and their frequency of application; splints and appliances, with their commencement and discontinuance; minor operations; massage; electrical, mechanical, hyperæmic, and hypnotic treatment; medicines, sera and vaccines used.

The "Final note on discharge" is important and should never be omitted. It should state briefly, but accurately, the condition of the patient and the mode of disposal, should give an idea of the prognosis, indicate any further treatment that may be required, and be legibly signed with the medical officer's name and rank.

A four-hourly chart is used where necessary, and on this or on the night and morning chart, A.F. B181, it is convenient to record by writing vertically under the date, various items of treatment, such as "operation," "daily hot-air bath," "massage," "daily ionization with sod. sal.," "weight extension applied," "X-ray taken," and so on. The weight of the patient can be similarly recorded.

One case-sheet is convenient for most cases, and contains the complete set of headings. A "continuation sheet" with simple identification headings is provided for use when required. This latter sheet can be used for the post-mortem report, which is copied from a manuscript book in which the post-mortem records are kept. Operation, X-ray, pathological and electro-therapeutical data are kept in columned books in their various departments.

A card-index facilitates reference to the patient's records. Note-taking should be as terse and brief as possible, any description of the patient's facies and disposition is usually unnecessary.

Suffering humanity, medical science and military medicine will all alike benefit by as full a study and record as possible of the injuries and diseases occurring in the present War, and it is in the hope of helping such study and record that this short paper is published.

CASE OF ORIENTAL SORE (BAGHDAD BOIL).

By Captain J. S. HUDSON.
Royal Army Medical Corps (T).

Lieutenant G. N. G. was admitted into hospital under my care on July 31 last, suffering from the above complaint. His history is as follows:—

In December, 1914, whilst employed as a mechanical engineer in the Persian Gulf, he was taken prisoner by the Turks and sent across the desert to Allepo, a journey of five hundred miles. His food consisted of dates, burrhl, hard-boiled eggs, and very occasionally meat. He left Allepo on January 9, i.e., towards the end of the date season, and three or four days later noticed a pimple on the right cheek for the first time. About March the swelling on the face, which had increased in size, began to discharge a yellowish material. During this time his general state of health had been good. He reached Tarsus at the end of January: on this journey he lived chiefly on tinned food. On his arrival at the latter place he had an attack of diarrhœa which lasted five days, and he then noticed a red spot on the right forearm.

On his return to England about June he began to feel depressed, had a disinclination for food, occasional retching in the early morning, feeling dull, and taking no interest in things generally. He also suffered from severe frontal headaches. During his stay in Tarsus he suffered from intermittent attacks of high temperature, which have occasionally occurred up to the time of his admission.

On admission, a healthy-looking man, aged 36, with a sore on the right cheek, the centre of which is scabbed over with a very thick covering with a depressed centre. On lifting the scab a little blood and thick pus escapes. The scab is oval in shape, about the size of a sixpence, around the sides and at the lower part are three or four layers of a thin flaky material. Surrounding the whole scab is a somewhat thick indurated tissue extending up to the lower eyelid. The cervical glands are enlarged. The sore on the right forearm is similar in appearance, but neither the scab nor the surrounding induration is as large as on the face. At the upper part of the right axilla a very small indurated spot is to be seen and felt, and the patient tells me that this is the manner in which the original sores developed. This spot he has only noticed within the last few weeks.

I decided to treat the sore on the face with CO_2 snow and to scrape the one on the forearm under an anæsthetic. I obtained my pencils from a local chemist and found that they lasted on an average well over half an hour.

The following notes show the results I obtained: August 4: First application with CO_2 pencil, duration, one minute. Has not felt so well and has vomited after his breakfast. August 7: Second application.

The induration has decidedly diminished since the first application and the scab is smaller in size. August 9: The scab on the cheek has fallen off and there has been no discharge since. It has left a clean granulating surface through which hairs are growing. Dressed spot with boracic ointment and iodoform. The general condition of the patient has much improved. August 18: Another small scab has appeared on the cheek and a further application of a CO_2 pencil was made for half a minute duration, also an application was made to the spot on the axilla. August 28: The lower part of the scab on the face has fallen off and a further application has been made to it.

Two further applications were made, one on August 31 and another on September 5. I scraped the sore on the forearm on August 7, and dressed the wound daily with boracic and iodoform. With the exception of some induration the wound had healed by the 18th.

As the scab on the face had quite disappeared and showed no signs of return, and as the patient's general state of health had much improved, I discharged him back to duty on September 8, one month after admission. I examined him again towards the end of October and found all three sores completely healed. On very close inspection one can see an oval-shaped whitish scar on the face, but there is no trace of induration or of glandular enlargement. A similar appearance is on the forearm, and the spot on the axilla has quite disappeared. He states that he has never felt better and all traces of headache and depression have long since disappeared.

I examined several specimens of the pus, using Leishman's stain, and found numerous *Streptococci brevis*, also several mononuclear cells were present and a very few but good specimens of *Leishmania*. A culture from the pus produced after twenty-four hours a growth of *S. brevis*.

The case is of interest from two points of view—one its origin and secondly the treatment. The disease has been attributed to eating dates in the early date season, but in this case it was the late season in which the boil appeared. It has also been attributed to the bites of fleas, and in this case the patient had been frequently bitten and living under the worst possible conditions. He informed me that the disease is extremely common around Baghdad. Secondly, with regard to treatment, I think the best result was with the CO_2 pencils, the induration around the sore to which I applied it has completely disappeared, whereas the sore on the arm which I scraped has almost gone but there is still a very slight amount of induration to be felt.

THE DRY AND THE WET METHODS OF WOUND TREATMENT CONTRASTED.

By Major C. W. DUGGAN.
Royal Army Medical Corps.

In the treatment of wounds during the present War the enunciation of a principle almost as important as the use of antiseptics does not appear to have been sufficiently stated by advocates on one or the other side. I allude to the question as to whether a wound is placed under a better condition for healing by wet or by dry dressing, and I take as an example of the latter a whitlow which has been opened and dressed with wet boric lint. Can there be anything more exasperating than to find day after day suppuration continuing, and so little improvement, when one considers the small size of opening made.

The treatment of septic gunshot wounds by baths is much in vogue at the present time. So impressed are the authorities at a certain large military hospital by this method that they contemplate adding to the accommodation.

As the following case bears on this point I shall refer to it at some length:—

No. 10631 Private A. H., 7th Battalion Norfolk Regiment, on October 13, 1915, was hit in the left hand by a bullet from a Maxim while he was in a German trench; first aid was applied, and he then walked to the field ambulance, where a dry dressing was put on. He was sent to Rouen for three weeks; he was next transferred to the Fourth Northern General Hospital, Lincoln, where he remained nineteen days under treatment, and then he came under my care in the Military Hospital, Lincoln. On admission he stated that the two end digits of his left ring-finger had been removed at the Fourth Northern General Hospital; to relieve suppuration, two incisions had been made in palmar surface of hand, viz., one at little finger, another in centre of palm; and there was a third incision one inch above front of wrist; a drainage-tube had been passed from this wound to the wound in centre of palm. I removed the drainage-tube at the first dressing, and did not replace it; no useful purpose was served by it, as the anterior annular ligament of the wrist so effectually compressed the tube as to render its presence useless.

As a substitute for drainage-tubes I always syringe out with pure sp. vini rectificat, and in this case the spirit passed readily from the wound in the palm out at the wound above the wrist; a sinus extended from this wound for two inches above; the skin of the hand was in a very sodden state from previous wet dressings, the hand was much swollen, exceedingly painful, and suppurating freely; it had been kept in water for forty-eight hours, during which time the patient had had no sleep. Equal parts of ichthyol and glycerine were painted on the wounds twice daily, and where the drainage-tube had been

pure spirit was run through once daily. In one week the wounds had contracted, the discharge was less, and there was no pain in the hand. On the tenth day after admission there was no discharge from the wounds, the swelling of the hand had gone down, and there was no return of pain, and the patient could move his fingers and wrist freely without pain. On the thirteenth day the wounds in the hand had healed, and the wound above the wrist was about the size of a sixpence; this had completely healed in another week. In this case there was no improvement during nineteen days' wet dressing, but a change to a dry, or, I might say, drying, method of treatment resulted in rapid contraction of the wounds and cessation of suppuration. I believe that the best dressing for a wound besides having an antiseptic action should at the same time tend to cause a drying up of the tissues with which it is in contact. How many of the various applications now in use fulfil these conditions? I should be glad to hear the views of other medical officers on this question.

RECRUITING NOTES.

By Lieutenant-Colonel H. W. WEBBER.

Royal Army Medical Corps (T.F.).
Administrator, 4th Southern General Hospital.

On November 29, 1915, I received a request from the A.D.M.S., Plymouth, to make arrangements for two medical officers from this unit to assist daily during the "rush" under Lord Derby's scheme, at the Recruiting Office, Plymouth.

Having done no (or very little) professional work since mobilization, and the machinery of the three hospitals under my charge running smoothly under a time of little pressure, I thought that a change of work from administration was desirable, and accepted the duty for myself. The result is the following brief notes, which may be of interest.

During the greater part of the time I was associated in the work with Staff-Surgeon T. E. Honey, R.N. (retired), to whom I am indebted for valuable collaboration and opportunity to include some of his cases.

(1) *Procedure.*—The usual methods laid down in recruiting regulations were followed, with the exception that the eyesight test was not carried out. The most arduous part of the day was the evening, when after five hours' work without food, and in a not too pure atmosphere, one became very fatigued.

(2) *Class of Men.*—Mostly labouring men, clerks, many dockyard workers, and a sprinkling of the middle classes and professional men. Very few single men appeared, and many of those were under standard. The physique of those presenting themselves was as a whole much better than might have been expected in these "degenerate" times.

(3) *Numbers.*—No exact record was kept, but the number examined by my colleague and myself during the eleven days was about 850, about 38 a day each.

(4) *Causes of Rejection.*—The usual causes were not found in any striking degree. I saw few hammer-toes, flat-feet, hæmorrhoids, or varicoceles. The latter disability well bore out the now accepted view, that the psychical factor is the chief element. Men who knew they had a varicocele presented themselves wearing suspenders and complained of aching in the groins and back, while I saw many cases of extreme degree who complained of nothing, and were not even aware of the existence of the trouble. Varicose veins of the legs were common, but here again many men with badly enlarged veins thought nothing of it, whereas others with slight abnormality made much of their trouble. All this class of case, unless of great severity, was not rejected as unfit as in ordinary times, but ear-marked for home service or garrison duty.

(5) *Cases of Special Interest.*—(*a*) A labouring man, aged 25, presented himself to Staff-Surgeon Honey, with a tumour behind the knee occupying completely the popliteal space. The swelling was of the size and shape of a coco-nut, uniform, smooth, elastic, painless, and causing the man no particular trouble. A fluid impulse could be obtained from it to the side of the patella, and on flexing the joint and pressing on the swelling the whole of its fluid contents could be pushed into the synovial cavity of the joint and its extension under the extensor muscles of the thigh, leaving a collapsed sac through which an opening in the posterior ligament of the joint received the index-finger. This was obviously a Morrant Baker's cyst of unusual size.

(*b*) Two cases of supernumerary nipples were seen; in one case there was one only, on the left side, two inches below and internal to the usual nipple; in the other a supernumerary nipple was present on each side in a similar position.

(*c*) Several interesting cases of syphilis occurred. In one a man presented a firm oval smooth painless tumour in the rectus muscle of the thigh. The nature of this was not at first obvious until further examination disclosed a copper-coloured eruption of serpiginous outline over the right temple and enlargement of the occipital lymph glands.

In another a roseolous rash on the forearms caught the eye of the examiner and inspection revealed a Hunterian chancre. Cases like this in a poor light and under the stress of examining large numbers of men might easily be missed.

(*d*) It was very remarkable to see the number of men, often intelligent, quite unaware of the presence of a hernia, even scrotal. This disability was found to be the commonest cause of rejection, and at least seventy per cent of the cases were double bubonoceles. Though mostly occurring in cases of poor general physique, it was most disappointing to be compelled to refuse an otherwise healthy man for a minor trouble, curable by an easily performed and most satisfactory operation.

Lecture.

A CLINICAL LECTURE ON ANEURYSMS OF WAR WOUNDS.[1]

By Major W. McADAM ECCLES, M.S., F.R.C.S.

Surgeon to St. Bartholomew's Hospital and the 1st London General Hospital, R.A.M.C., T.F.

Gentlemen.—The War is multiplying instances of lesions which, although observed in civilian practice, are not common therein. Traumatic aneurysm is an instance of this.

By a traumatic aneurysm is understood an abnormal swelling associated with a blood-vessel, and caused by a trauma or wound of the vessel. There are several varieties of such swellings, and these may be conveniently classified thus:—

(*a*) Traumatic arterial aneurysm. (i) Diffused. (ii) Circumscribed.

(*b*) Traumatic arterio-venous aneurysm. (i) Aneurysmal varix. (ii) Varicose aneurysm.

The characters of these varieties will be seen by reference to the diagrams.

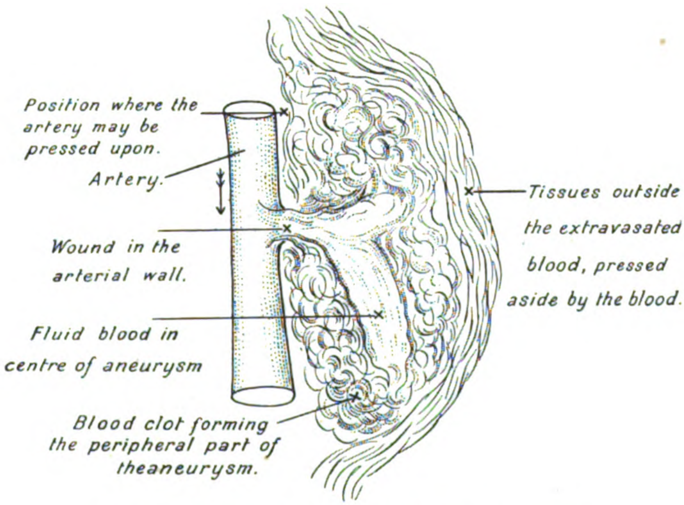


Fig. 1.—Diagram of a diffused traumatic aneurysm.

Traumatic Arterial Aneurysm.

The first is a diffused traumatic arterial aneurysm, and shows all three coats of the artery damaged (fig. 1). Immediately blood pours out from

[1] Delivered at St. Bartholomew's Hospital, November 17, 1915.

the aperture and clots externally, though liquid blood still remains in the centre. The surrounding tissues are pushed away from their proximity to the artery, consequently a cavity is formed without any real wall; hence there is no sac, and the lesion is not a true aneurysm, for an aneurysm has a sac wall.

Then there are three varieties of circumscribed traumatic arterial aneurysm. In the first of these the blood is poured out in exactly the same way as above, but by clotting it has acted as a foreign body, and inflammation occurs around and produces condensation of the tissues so as to form a pseudo-sac, so that for all practical purposes there is a sacculated aneurysm circumscribed by a false sac wall (fig. 2, *a*).

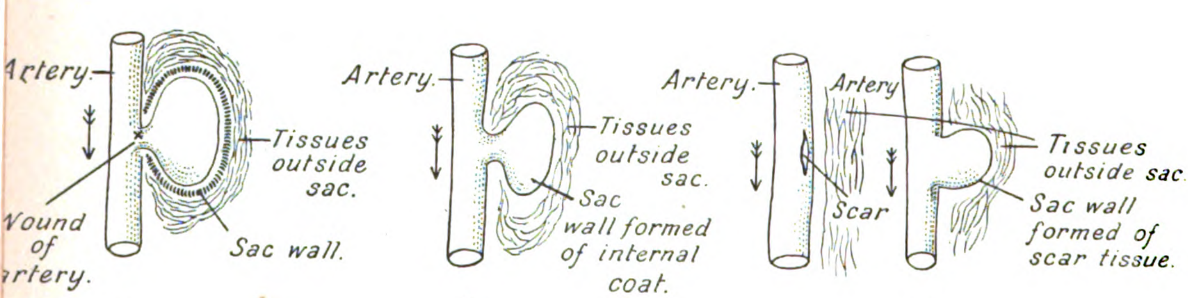


FIG. 2.—Diagrams of circumscribed traumatic aneurysms.

The second variety is much less common. Frankly, I am not sure that it really occurs, but as it is given a place in some text-books I mention it. There has been a wound of the external and middle coats of the artery, the internal coat remaining undamaged. Obviously, the pressure of blood on the thin internal coat is enough to make it bulge, and for the time being a circumscribed traumatic aneurysm exists, but as the pressure becomes greater, the thin sac wall gives way ere long (fig. 2, *b*).

The third variety is that in which there has been a wound of the artery which has healed, but the scar is a weak spot. This may afterwards become distended by the intra-arterial pressure, and an aneurysmal sac will be formed (fig. 2, *c*).

TRAUMATIC ARTERIO-VENOUS ANEURYSM.

The next diagram will show you the two varieties of arterio-venous aneurysm, in which there is a wound of both the artery and the adjacent vein, and a communication between the two. The commonest form of an arterio-venous aneurysm is an aneurysmal varix (fig. 3). As a result of the communication which has been established between the two, part of the arterial blood passes through this communication, and goes distal-

wards along the vein, thereby obstructing somewhat the return of blood through the vein, and the vein becomes enlarged at the level of the junction of artery and vein.

The other variety is where there is a true aneurysmal sac lying between the artery and vein (fig. 4). There has been a wound of the artery and the vein. The two vessels have not come into contact, but blood passes from one to the other, and a pseudo-sac forms between the two. The blood-pressure in the artery being the higher, the blood passes through the sac and into the vein, and the vein tends to bulge opposite the site where the sac communicates with the vein. The War has produced a larger number of these cases than we have had for a long time, and I think it will go on producing them.

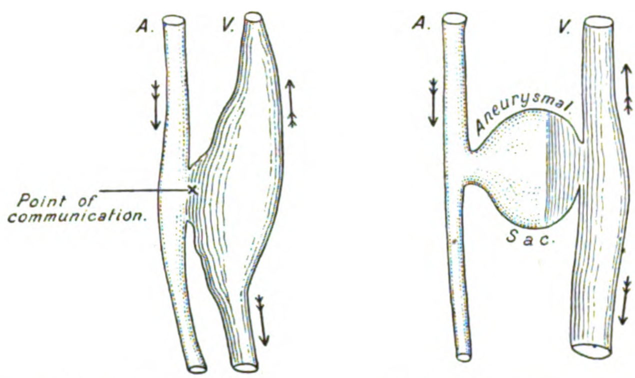


FIG. 3.—Aneurysmal varix. FIG. 4.—Varicose aneurysm.
Two types of arterio-venous aneurysm.

ANALYSIS OF FIFTY CASES.

In the October, 1915, issue of the *British Journal of Surgery* are collected fifty cases of traumatic aneurysm. I have analyzed them in the table on page 408.

With regard to the arteries of the head and neck, the cases were seven in number. It might have been thought that arteries in this region would have been more commonly injured than those elsewhere. But it has to be remembered that if a man is shot in the neck and even has his common carotid artery wounded, he may not get very much external bleeding, but other important structures in the neck may be damaged, such as the vagus, and death results.

The lower limb is the site in which traumatic aneurysms mostly occur. The superficial femoral was injured in eight and the popliteal in thirteen, and it is a very interesting fact that the popliteal artery is also the commonest site in a limb for a pathological aneurysm. I think this

may be explained in two ways. First of all, wounds of the leg are common; at any rate, soldiers who receive wounds in the leg frequently survive. The second reason is that the popliteal artery has very little tissue surrounding it except fatty tissue, which gives very little support.

With regard to the mortality shown in the table, this is strikingly low, because it would have been expected, in these cases, to have a very much higher mortality than this series shows. There were four deaths in the fifty cases, a percentage of only eight. None of the popliteal cases died.

Analysis of Fifty Recorded Cases of Traumatic Aneurysm.

Number, 50.
Types: Arterial, 30; arterio-venous, 20.
Position:

Head and neck		7
Upper limb		14
Lower limb		29

Arteries involved—

Head and Neck:		
External carotid	1	
Facial	1	
Superficial temporal	1	
"Base of skull"	1	
Common carotid	3	= 7
Upper Limb:		
Subclavian	2	
Axillary	5	
Brachial	5	
Ulnar	1	
Radial	1	= 14
Lower Limb:		
Common femoral	1	
Superficial femoral	8	
Deep femoral	1	
Popliteal	13	
Posterior tibial	5	
Anterior tibial	1	= 29

Mortality. Deaths: 4 = 8 per cent.

Vessels involved:		
Common carotid	1	
Subclavian	1	
Superficial femoral	2	= 4

Signs and Symptoms.

Now, a word or two with regard to the local signs and symptoms of these traumatic aneurysms. The first is a swelling in the line of the vessel. It may be very slight, but it is usually quite evident. Secondly, this swelling pulsates, and the pulsation has practically all the signs of that of an aneurysm seen in civilian practice, i.e. it is expansile; it

ceases when the main artery is compressed on the proximal side of the swelling, and it begins again with a series of pulsations corresponding to the pulsations or beats of the heart when the pressure is removed. There is also a bruit, and the bruits of these traumatic aneurysms are usually much more marked than of the ordinary pathological aneurysm. The bruit of an arterio-venous aneurysm has its own distinctive character, namely, that of being a continuous humming or buzzing bruit. It is very distinctive when once heard. Again, the thrill which is present in these traumatic cases is more harsh than in aneurysms met with in ordinary practice. Sometimes, when there is a good deal

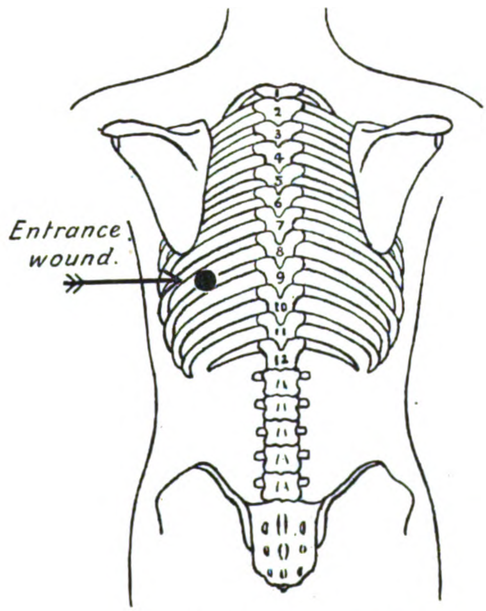


FIG. 5.—Case of Sapper G. W.

of clot, there are few, if any, local symptoms or signs other than swelling. Pulsation may disappear, bruit may cease, and thrill may entirely go so that swelling alone is left, and the aneurysm is on its way to become cured. With regard to the distal signs and symptoms, there is practically always some œdema of the distal part of the limb, which is due to the aneurysmal swelling pressing upon the vein, and so preventing a proper return of blood; and secondly, that the *vis a tergo*, the force behind in the artery, is diminished in the periphery, with the result that the blood does not come back so easily in the veins, and so œdema results. For the same reasons congestion, due to dilation of the superficial vessels, is produced. Further, there is

an alteration of the pulse. The pulse on the affected side is smaller, and very frequently it is delayed as compared with the sound side. And, lastly, there is very characteristic pain, pain due to pressure upon the main nerves at the site of the aneurysm, but referred to the periphery.

Before proceeding, I want to give you the history and some diagrams of two cases of injury of arteries—the second with a distinct aneurysm—which have been treated at the 1st London General Hospital since the publication of the fifty cases in the *British Journal of Surgery*.

The first is a case of wound of the right common femoral artery. Sapper G. W. was wounded on August 26, 1915, the bullet entering the thorax below the lower angle of the *left* scapula (fig. 5). There was immediate dyspnœa, and later he had hæmoptysis. From the latter he soon recovered.

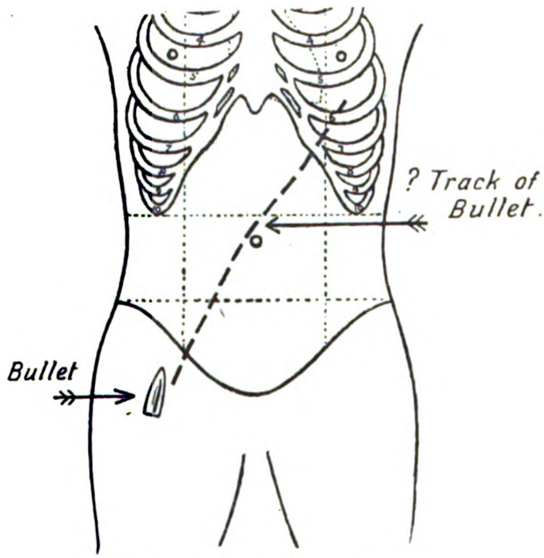


Fig. 6.—Case of Sapper G. W.

On September 30 twenty-four ounces of blood-stained pleural fluid were evacuated. He had pain on the left side of the chest running up to the axilla. He was admitted under our care at the 1st London General Hospital on October 16, and on that date he had no physical signs on the left side of the chest. No exit wound could be discovered, and on X-ray examination a bullet was discovered in the *right* groin, with the point turned upwards; evidently it had turned during its passage through the tissues, as the entrance wound was very small (fig. 6).

It will be observed that the bullet traversed part of the thorax downwards across the abdomen and into the groin. At the operation, nine

weeks after the wound, the sharp point of the bullet was found to have penetrated the wall of the common femoral artery (see fig. 7), and was surrounded by blood-clot. I ligatured the vessel on the proximal side, but on removing the bullet there was furious hæmorrhage. This was due to the fact that in the interval between receipt of the wound and the operation there had been time for an efficient collateral circulation to be established, and it was from the superficial and deep femoral arteries

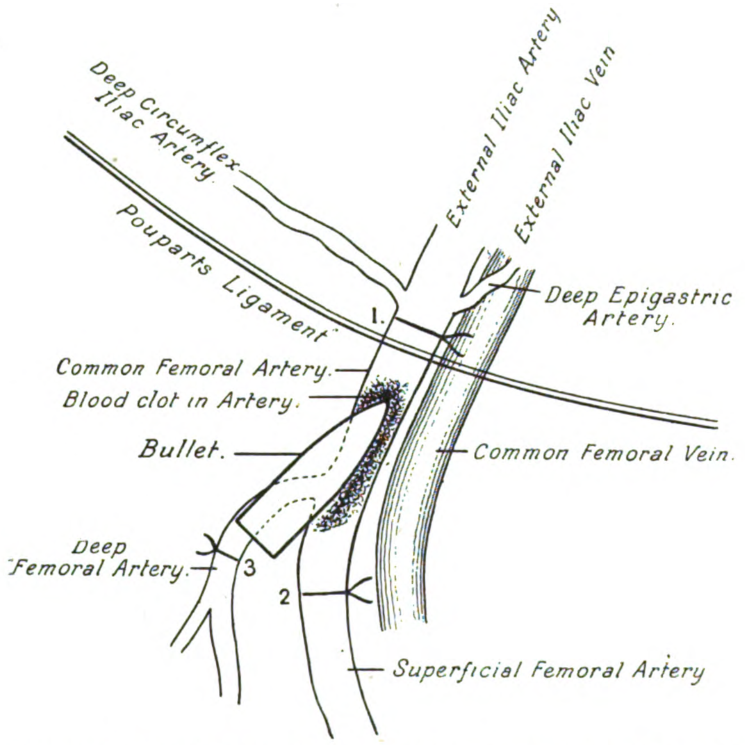
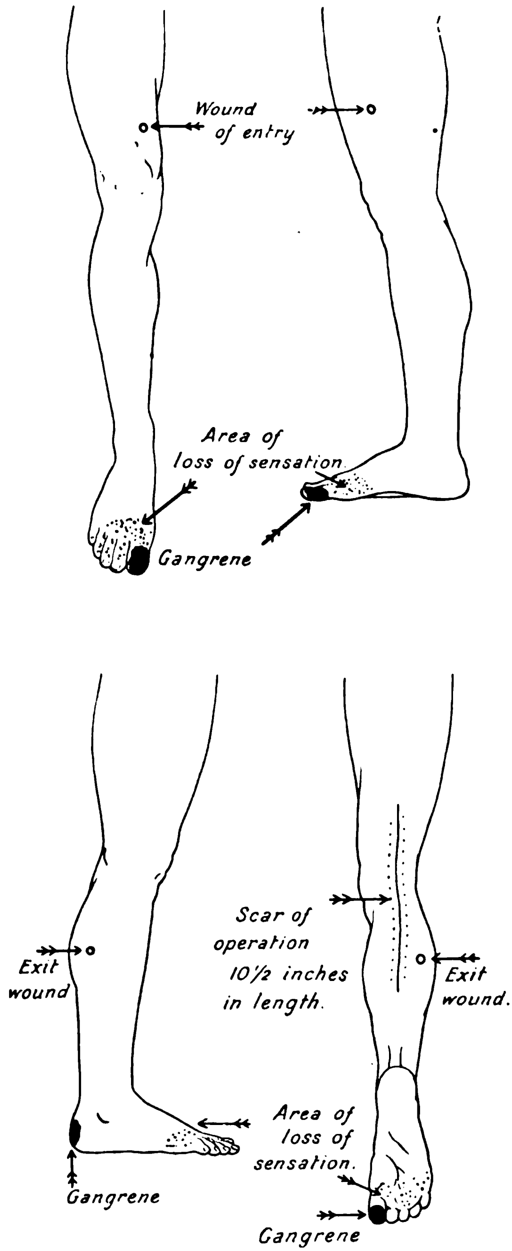


FIG. 7.—Diagram to illustrate the position of the bullet before extraction. (1) Ligature on the right external iliac artery; (2) ligature on the right superficial femoral artery; (3) ligature on the right deep femoral artery.

that the hæmorrhage occurred. I had perforce to ligature both these branches of the common femoral before bleeding could be arrested.

The case has made an uninterrupted recovery, the pulsation in the posterior tibia being now quite strong, and there has been no œdema of the foot, or any suspicion of even superficial gangrene. There was no damage to any of the veins.

The next case is that of Serjeant James F., aged 25, who was



FIGS. 8 and 9.—Diagrams to illustrate a case of traumatic aneurysm of the right popliteal artery (Serjeant James F.).

wounded on September 24, 1915, by a bullet from a machine-gun. It entered above the inner side of the right knee, and made its exit on the outer side of the right calf (see figs. 8 and 9). He was admitted to the Liverpool Merchants' Hospital on September 28, 1915. The right foot was at that date cold, bluish, having no perception of touch, and no pulsation could be detected in the posterior tibial artery. There was no swelling to be either seen or felt in the right popliteal space; but by means of the stethoscope a loud bruit could be heard which was conducted some way down the right leg.

On October 3 he complained of severe pain in the right calf, and there was some discoloration. There was no improvement in the condition of the right foot, and gangrene was threatening. On October 4 an incision was made over the back of the lower part of the thigh and upper part of the leg, 10½ in. in length. The contents of the aneurysm were turned out, and the popliteal artery was tied on the proximal and distal sides of the sac. The popliteal vein was also found to be damaged, and was therefore ligatured in two places. The leg was discoloured, but that was chiefly due to extravasated blood. The next note is dated October 29, and then there had been steady improvement since the operation, though a good deal of pain was still being felt in the foot, and the end of the right big toe was black. No definite line of demarcation had, however, yet formed. There were to be seen superficial gangrenous patches on the heel and the fifth toe, and some œdema about the ankle. The range of movement of both right knee and ankle was somewhat restricted. He was admitted to the 1st General Hospital London on October 30, and on November 5 the patches of gangrene still remained, and though movement of knee and ankle was still restricted, the limitation was less than formerly (figs. 8 and 9).

Treatment.

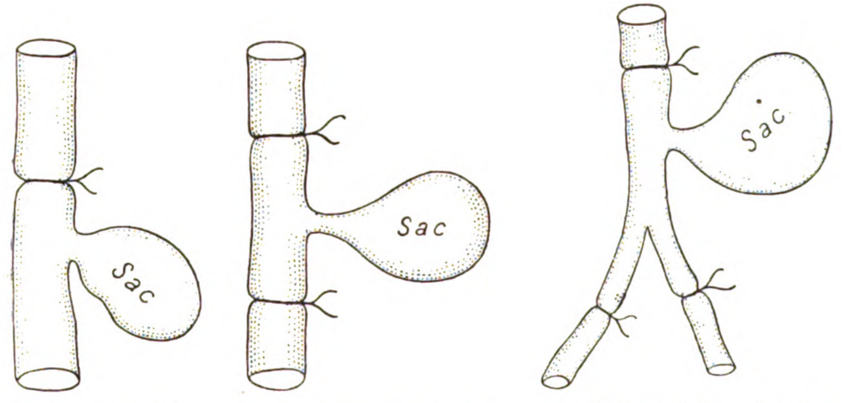
With regard to the treatment of traumatic aneurysms there are one or two important general points. First, do not deal with them by operation until such a procedure becomes absolutely necessary, for by waiting as long as possible there is a chance for a collateral circulation to be established, and there is less likelihood of the occurrence of gangrene. Another case of mine, recorded in the *British Journal of Surgery*, was that in which I had to ligature the common femoral artery, because the man had a rapidly enlarging aneurysm following trauma. The operation was performed within four days of his injury, and gangrene immediately supervened, and I had to amputate through the middle of his thigh in order to save his life.

Secondly, be prepared for violent hæmorrhage. It may not always be possible to apply a tourniquet on the proximal side of the aneurysm. It is in these cases that a skilful assistant is of the highest value.

Thirdly, make a good incision so as to have abundance of room within which to work.

There are at least three possible methods of dealing with traumatic arterial aneurysms: (1) Ligation of vessels; (2) operation on the sac; (3) amputation.

(1) *Ligation of Vessels.*—To ligature the main artery on the proximal side of a traumatic aneurysm is almost certain to be followed by gangrene in the periphery unless there has been time for a sufficient collateral circulation to become established. To ligature the main artery alone on the proximal side, even when no gangrene follows, is a somewhat risky procedure, and never a certain cure. It is risky because it may not control the bleeding; it is uncertain because the aneurysm may advance even in spite of the ligation. The application of ligatures on the artery or arteries, on the proximal and distal sides of the aneurysm, is quite the best method of treating these cases. It is fairly easy, it should effectually stop hæmorrhage, and is not more likely to be followed by gangrene (fig. 10).



A. Ligature of the main artery on the proximal side only.

B. Ligature of the main artery on the proximal and the distal side.

C. Ligature of the main artery on the proximal side and of two branches on the distal side.

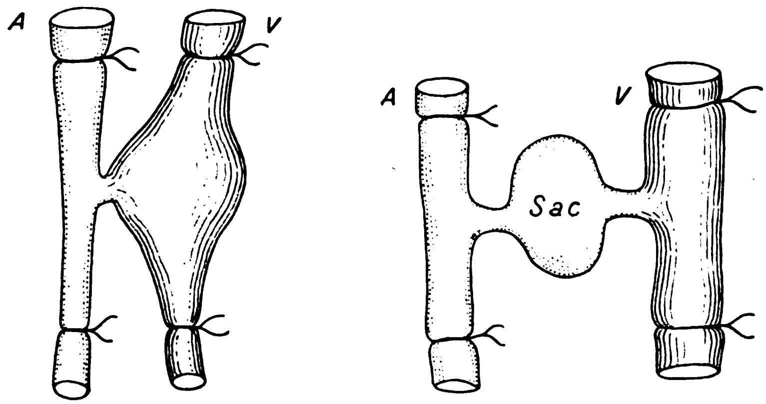
FIG. 10.—Traumatic arterial aneurysm.

(2) *Operation on the Sac.*—A tourniquet having been applied on the proximal side, the aneurysmal sac is exposed by a good length of incision, and an opening made into it. The clot is turned out, and the mouth of the vessel entering and leaving it found. A probe may now be passed into each vessel, the vessels exposed externally above and below, and a ligature applied to each. The sac itself may be excised in many cases. This is an ideal method of treatment but not altogether an easy one, and causes a good deal of disturbance, particularly if the wound is septic.

(3) *Amputation.*—Not only is amputation required if gangrene has

supervened, but it may be the safest as a primary treatment where there is a diffused traumatic arterial aneurysm.

An arterio-venous aneurysm, whether of the type of aneurysmal varix or varicose aneurysm, is best treated by a ligature of both vessels on both sides of the communication between the artery and vein, and if possible an excision of the portion intervening, and of the sac if there be one (fig. 11).



A. Proximal and distal ligatures in an aneurysmal varix.

B. Proximal and distal ligatures in a varicose aneurysm.

FIG. 11.—Traumatic arterio-venous aneurysm.

The mortality after these operations is not so great as would be supposed. In the table it will be seen there were only four deaths, making a mortality of only 8 per cent.

The vessels involved in the fatal cases were the common carotid once, the subclavian once, and the superficial femoral twice.

Report.

CLINICAL REPORT ON THE APPLICATIONS OF EUSOL.

Report to the Medical Research Committee.

In response to a request from the Medical Research Committee (National Health Insurance), an investigation on the use of antiseptics was undertaken in the Department of Pathology in the University of Edinburgh, in January, 1915.

A paper embodying the experimental and clinical results of the investigation was published in the *British Medical Journal*, by Drs. Lorrain Smith, Murray Drennan, Rettie and Campbell, on July 24, 1915.

Comparison of different types of antiseptics led to a general conclusion that *hypochlorous acid* is of the highest value in the treatment of septic wounds. At the date of the publication in July a considerable amount of surgical experience on the subject had already accumulated, and it was felt that extended clinical investigation was called for. This was determined on at a meeting of surgeons summoned by the President of the Royal College of Surgeons, Edinburgh, and held on August 10.

On the motion of Surgeon-General Bourke, D.D.M.S., seconded by Professor Harvey Littlejohn, Dean of the Medical Faculty, the meeting appointed the following Committee to prepare a report:—

Major Hodsdon, President of the Royal College of Surgeons, Edinburgh (Chairman).

Lieutenant-Colonel Caird, Vice-President of the Royal College of Surgeons, Edinburgh; Professor of Clinical Surgery, University of Edinburgh.

Colonel Cotterill, Senior Surgeon, 2nd Scottish Military Hospital, Craigleith.

Lieutenant-Colonel Cathcart, Senior Surgeon, Edinburgh War Hospital, Bangour.

Major Wallace, Red Cross Commissioner, Eastern Division of Scotland.

Captain Stiles, Surgeon to Edinburgh War Hospital, Bangour.

Dr. A. H. F. Barbour, President of the Royal College of Physicians, Edinburgh.

Dr. Graham Brown, Curator of the Royal College of Physicians Laboratory, Edinburgh.

Dr. Lorrain Smith, Professor of Pathology, University of Edinburgh.

Dr. James Ritchie, Professor of Bacteriology, University of Edinburgh.

Secretaries:—

Dr. A. Murray Drennan, Professor of Clinical Pathology, University of Otago, New Zealand.

Dr. Theodore Rettie, Research Assistant under Medical Research Committee.

The present report is based on experience extending over the last ten months. Eusol was first used by Captain Stuart in the Deaconess Hospital on March 4, 1915. He reports as follows: "The cases on which it was used were the ordinary very septic bone and other wounds which are found in a military base hospital. Its success was so immediate that it displaced all other antiseptics in the treatment of these cases in this hospital."

The following report includes a number of records of military and civil cases which have been collected since that date.

The preparations of hypochlorous acid which have been applied are those described in the paper published in July, and recommended after an extended experimental investigation.

Solutions of *alkaline* hypochlorites have long been employed as antiseptics: on the other hand, solutions of *hypochlorous acid* have not been generally employed.

There is evidence, however, that *chlorine water* owes its antiseptic power to the presence of *hypochlorous acid* in solution, and in this connection it is interesting to refer to a case treated by Lister in which he found the liquor chlori of the old British Pharmacopœia an effective antiseptic when a one in five spirit solution of carbolic acid had failed. ("Remarks on a Case of Compound Dislocation of the Ankle," 1870, Collected Papers, vol. ii, p. 155.)

The intense germicidal power of hypochlorous acid solution was demonstrated in 1903 by Andrewes and Orton (*Cent. f. Bakt.*, 1903-04), but they did not devise a method of preparing a solution suitable for surgical practice. While, therefore, the antiseptic power of hypochlorous acid has been known for a long time, its practical value has not been fully appreciated. The difficulties encountered in the treatment of sepsis in the present War led to the investigations which have proved that hypochlorous acid can be applied to an extent hitherto unsuspected. This general conclusion is confirmed by observers who have worked with dilute solutions of sodium hypochlorite (Dakin, *British Medical Journal*, August 28, 1915; Bowlby, *British Medical Journal*, December 25, 1915).

The cases recorded in the report have been placed under two headings, civil and military.

Of the civil cases, ninety-nine were treated in hospital and one hundred in the out-patient department. They include various types of septic lesions, the details of which have been summarized in Table A.

The military cases have been selected for the purpose of showing the applicability of the method to the treatment of wounds, both recent and those in which sepsis had been established for at least a week, and in some cases for months. (Table B.)

TABLE A.

CIVIL CASES.

No.	Disease	Surgeon and Hospital	Mode of application	Frequency of application	Result
1	Large varicose ulcer, weak granulations, copious discharge	Major Hodsdon, Royal Infirmary, Edinburgh	Wet, then dry dressing	1 per day	Showed marked improvement in twenty-four hours. Completely healed in thirty-nine days.
2	Varicose ulcer, slight discharge, no tendency to heal	Major Hodsdon and Mr. Wood, Royal Infirmary, Edinburgh	Eupad in gauze once, dry dressing then wet dressing	1 ,, ,,	Ulcer completely crusted over. Completely healed in five days, but broke down later.
3	Varicose ulcer, slight thick discharge	Colonel Thomson, Royal Infirmary, Edinburgh	Dry dressing	1 ,, ,,	Healed steadily.
4	Varicose ulcer, free discharge	S.O.P.D., Chalmers Hospital	Soak and eupad	1 ,, ,,	Great improvement.
5	Carcinoma of rectum. Operation	Major Hodsdon and Mr. Wood, Royal Infirmary, Edinburgh	Eupad and eusol syringed	1 per day begun on third day	Discharge practically ceased in one month.
6	Carcinoma of rectum. Operation	Capt. Stiles, Chalmers Hospital	Eusol quarter strength syringed	—	Healed by first intention.
7	Laceration extending from groin to knee, inner side of thigh (accident), vessels exposed	Captain Miles, Royal Infirmary, Edinburgh	Irrigation and soaks	Every six hours	Sloughs separated in ten days. Discharge ceased and notable healing in fifteen days.
8	Severe burn ..	Captain Miles, Royal Infirmary, Edinburgh	Eupad on gauze + vaseline	—	Rapid granulation and steady improvement; treatment not irritating.
9	,, ,, on thorax	Capt. Stiles, Royal Hospital for Sick Children	Eusol, soak	2 per day	Sloughs entirely separated in five days. Child discharged two days later.
10	Cystitis. Man aged 75. Not expected to recover	Colonel Thomson, Royal Infirmary, Edinburgh	1 in 8. Irrigation	2 ,, ,,	Patient improving in four days. Discharged in six weeks.
11	T.B. Periostitis with abscess formation and ulceration	Captain Miles, Royal Infirmary, Edinburgh	Soak + pot. iod. internally	1 ,, ,,	Operation; marked improvement in six days.
12	T.B. Arthritis knee, sinus	Captain Miles, Royal Infirmary, Edinburgh	Wet dressing	—	Rapid healing after opening up and scraping.
13	T.B. Tarsus, scraping	Captain Miles, Royal Infirmary, Edinburgh	Eupad 1 day, wet dressing subsequently	—	Clean and healing in seven days after operation.
14	Sinus, T.B., 4 years' standing	Captain Miles, Royal Infirmary, Edinburgh	Eupad gauze 3 days, soaks + pot. iod. internally	—	Completely healed in seven weeks.
15	Specific ulcer ..	Captain Chiene, Royal Infirmary, Edinburgh	Soaks ..	1 per day	Ulcer healthy in fourteen days.

TABLE A. CIVIL CASES—*continued.*

No.	Disease	Surgeon and Hospital	Mode of application	Frequency of application	Result
16	Specific ulcer: very foul	Captain Chiene, Royal Infirmary, Edinburgh	Soaks ..	1 per day	Ulcer healthy in fourteen days.
17	Lacerated wounds (scalp)	Mr. Alexander, Royal Infirmary, Edinburgh	Eupad rubbed in	—	In forty-eight hours wounds clean.
18	Crushed pelvis, extensive cellulitis (accident)	Captain Dowden, Royal Infirmary, Edinburgh	Eupad applied freely, 3 to 4 drm.; later lavage of bladder with eusol	Later half strength 2 per day	Case discharged cured in eight weeks.
19	Hydatid cyst ..	Captain Dowden, Royal Infirmary, Edinburgh	Douched, 2 pints, half strength	—	Cavities drained; satisfactory recovery.
20	,, ,, ..	Captain Dowden, Royal Infirmary, Edinburgh	Douched, 2 pints, half strength	—	Cavities drained; satisfactory recovery.
21	Septic cellulitis ..	Capt. Stiles, Chalmers Hospital	Eupad and eusol	Soak, four hourly	Cellulitis much decreased in six days.
22	T.B. Osteomyelitis, sinus	Capt. Stiles, Chalmers Hospital	Soak ..	2 per day	Treatment begun twenty-one days after operation; previous treatment H_2O_2; practically dry in three weeks.
23	Necrosis, lower jaw, for six months (operation)	Capt. Stiles, Royal Hospital for Sick Children	Eupad and eusol, half strength	1 ,, ,,	Very little discharge after six days.
24	T.B. Hip joint, fifth admission. Amputation through joint	Capt. Stiles, Royal Hospital for Sick Children	Eupad at operation; syringe and soak, half strength, subsequently	1 ,, ,,	Steady improvement for twenty days. Healed very quickly for a T.B. case.
25	Acute abscess abdominal wall (opened)	Capt. Stiles, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Wound healing in two days. Discharged in nine days.
26	Acute popliteal abscess (operation)	Capt. Stiles, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Healthy granulation in three days. Steady healing.
27	Acute suppurative appendicitis, retrocæcal abscess	Capt. Stiles, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improving rapidly in five days.
28	Acute suppurative appendicitis, pelvic abscess	Capt. Stiles, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improving rapidly in four days.
29	Acute suppurative appendicitis, retrocæcal abscess	Mr. Mitchell, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improving rapidly in six days.
30	Acute suppurative appendicitis, abscess	Mr. Mitchell, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improving rapidly in two days.
31	Acute suppurative appendicitis, retrocæcal and pelvic abscesses	Mr. Mitchell, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improving rapidly in nine days.
32	Acute suppurative appendicitis, peritonitis and pelvic abscess	Mr. Mitchell, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improving rapidly in eight days.
33	Acute appendicitis, gangrenous; drained four days	Mr. Mitchell, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Wound healed by first intention by eighth day.

TABLE A. CIVIL CASES—*continued.*

No.	Disease	Surgeon and hospital	Mode of application	Frequency of application	Result
34	Acute appendicitis, general peritonitis	Mr. Mitchell, Royal Hospital for Sick Children	Syringe and soak, half strength	1 per day	Rapid recovery.
35	Acute suppurative appendicitis, retrocæcal abscess	Miss Herzfeldt, Royal Hospital for Sick Children	Syringe and soak, half strength	1 ,, ,,	Improvement in three days.
36	Acute streptococcal infection of thumb; marked lymphangitis, axillary glands tender; temperature 1032° F.; two operations (nurse)	Capt. Stiles, Royal Hospital for Sick Children	Eupad at operations, eusol baths and soaks	Six-hourly	Eusol baths relieved pain. Wound healed rapidly after second operation.
37	T.B. Fibula sinus; excision of part of fibula	Capt. Stiles, Royal Hospital for Sick Children	Eupad at operation, soaks	1 per day	In two days very little discharge and healthy granulation. Healed in three weeks.
38	Sarcoma, jaw ..	Lt.-Col. Cathcart, Longmore Hospital for Incurables	Dry dressing	2 ,, ,,	No effect.
39	Epithelioma, neck ..	Lt.-Col. Cathcart, Longmore Hospital for Incurables	Washed and dry dressing	2 ,, ,,	Discharge greatly diminished.
40	Malignant ulcer (face)	Lt-Col. Cathcart, Longmore Hospital for Incurables	Syringe and soak	2 ,, ,,	Great improvement.
41	T.B. Empyema ..	Lt.-Col. Cathcart, Longmore Hospital for Incurables	Syringe and soak	1 ,, ,,	Discharge much reduced.
42	Cancer, lower jaw ..	Lt.-Col. Cathcart, Longmore Hospital for Incurables	Wet packs	2 ,, ,,	Very greatly diminished discharge.
43	,, vagina ..	Lt.-Col. Cathcart, Longmore Hospital for Incurables	Douche ..	1 ,, ,,	No definite change.
44	,, ,, ..	Lt.-Col. Cathcart, Longmore Hospital for Incurables	,, ..	1 ,, ,,	Discharge less, and much less offensive.
45	Gonorrhœal discharge	Dr. Finlay, Craiglockhart	Injection, eusol 1 in 5	3 injections	Discharge for twenty-four days; stopped in five days. Burning pain at first on injection, but decreased as discharge lessened and finally ceased.
46	,, ,,	Dr. Finlay, Craiglockhart	Injection, eusol 1 in 5	5 ,,	Discharge stopped in eight days. Pain experience similar to 45.
47	Cut on scalp, street accident, very dirty	Mr. Jardine and Lieut. Cameron	Eusol freely	Daily injections	Completely cured in fourteen days.
48	Crushed finger ..	Mr. Jardine and Lieut. Cameron	Eusol, soak for twelve hours before operation, then dry dressing	Daily injections	Rapid healing. Note: Eusol soaks to small, dirty wounds for twelve to twenty-fours before operating or stitching have been found very successful; drainage may then be dispensed with.

Ear and Throat Department, Royal Infirmary, Edinburgh.
Dr. Logan Turner. Dr. J. S. Fraser. Dr. H. Chaffer.

No.	Disease		Mode of application	Frequency of application	Result
49 to 76	T.B. Otitis media ..	Four cases ..	Syringe, half strength	2 per day	Eminently satisfactory.
	Tonsilectomy and enucleation of tonsils	Many cases ..	Sprayed ..	—	Membrane disappeared rapidly; fœtor of breath diminished; wound rapidly granulated.
	Operation for polypus of antrum	Two cases ..	Douche ..	2 per day	Rapid recovery.
	Supp. otitis media ..	Seven cases ..	Syringe ..	2 ,, ,,	All satisfactory.
	Atrophic rhinitis ..	Two cases ..	,, ..	2 ,, ,,	No better than other methods
	Mastoiditis ..	One case	,, ..	2 ,, ,,	Rapid improvement.
	Radical mastoid operation	Eight cases ..	,, ..	2 ,, ,,	Quite satisfactory.
	Cerebellar abscess ..	Two cases ..	,, ..	2 ,, ,,	Healed in one week.
	Cerebral abscess ..	One case	First dressings	Eupad and eusol	Quite satisfactory.

Eye Department, Royal Infirmary, Edinburgh.

77 to 88	Eleven cases	Dr. Traquair ..	"Eusol and eupad, while in some respects efficacious, did not show any advantages over weak simple lotions."

General Civil Cases (*continued*).

No.	Disease	Surgeon and Hospital	Mode of application	Frequency of application	Result
89	Acute appendicitis; general peritonitis	Mr. W. Q. Wood, Leith Hospital	Douche through abdominal cavity, half strength, later syringing with eusol	2 per day	Great improvement in a week. Wound nearly closed six days later.
90	Lacerated septic wound, hand	Mr. W. Q. Wood, Leith Hospital	Wet dressing	2 ,, ,,	In a few days sepsis gone; skin grafting.
91	Crushed finger, amputation. Persistent sinus	Mr. W. Q. Wood, Leith Hospital	Syringing and wet dressing	1 ,, ,,	Sinus had persisted for three months. Healed in four days with eusol.
92	Cellulitis of elbow ..	Mr. W. Q. Wood, Leith Hospital	Eupad applied to incisions.	—	Good recovery.
93	Septic wound, groin, following abscess on foot	Mr. W. Q. Wood, Leith Hospital	Wet dressing	2 per day	Sepsis had persisted for three months. Pus disappeared and healthy granulations in four days.
94	Partial avulsion of the scalp	Mr. J. M. Graham	Sponging with gauze soaked in eusol	—	Healing by first intention.
95	Severe laceration of right arm. Fracture of humerus	,, ,,	Sponging with gauze soaked in eusol	—	Healing by first intention.
96	Severe crush of both hands	,, ,,	Irrigation with eusol	—	Healing very satisfactory.
97	Compound comminuted fracture of elbow region	,, ,,	Irrigation with eusol	—	Healing very satisfactory.
98	Ulcerated wound, leg	Lieut-Col. Caird	Dressed with eusol	—	Satisfactory progress.
99	Compound fracture, humerus	,, ,,	Eusol purification	—	Good result.

Surgical Out-patient Department, Royal Infirmary.

Mr. J. M. Graham and Mr. Jardine.

One hundred cases were treated. These consisted of lacerated and contused wounds, cuts, septic ulcers, abscesses, whitlow, etc.

Of these, sixty-seven never showed sepsis; twenty-three were septic when they were admitted to the department; ten became septic after treatment, but experience showed that the cause of this was insufficiency in the application of eusol, e.g., one dry dressing in twenty-four to seventy-two hours.

Special note was made of ten cases in which an experimental first field dressing was applied, with the view of testing its power of preventing sepsis. It consisted of a pad of gauze in the centre of which were placed two grammes of dry eupad. The powder was moistened by fluid discharge from the wound, or where the wound was dry a little water was poured on the dressing. It was covered only by the bandage. The purpose was to test the disinfecting power of the hypochlorous acid gas given off from the moistened eupad.

This treatment was completely successful except in three cases. In one of these the patient returned after twenty-four hours, when the wound was found clean and a eusol dry dressing was applied. The patient then absented himself for seven days and at the end of this period he returned with the wound septic.

In the second case, a contusion of the scalp in a child aged 5, the wound remained clean for three days. It was then being treated with a dry dressing of eusol; this was insufficient to prevent the onset of sepsis, but it was cured by eusol soaks.

In the third case the wound became infected because the patient removed the dressing.

This subject deserves further investigation, but it can be adequately dealt with only in the field, for example, by the regimental medical staff or the field ambulance medical officers.

Details of Cases treated in Surgical Out-patient Department.

Accidental Wounds which did not become Septic.

Case No. 2.	Lacerated wound.	Case No. 16.	„ „
3.	Cut; glass.	19.	„ „
7.	Contused wound.	20.	Lacerated wound.
9.	„ „ head.	21.	„ „
10.	„ „	22.	Contused wound.
11.	„ „	23.	Crushed toe.
12.	Cuts.	24.	Glass cuts.
13.	Lacerated wound; cheek.	25.	Cut.
15.	Contused wound; head.	26.	Lacerated wound.

Case No. 27. Contused wound; scalp.
28. Cyst; operation; thumb.
29. Contused wound.
30. ,, ,,
31. Cut and bruises.
33. Cut and contused wound.
35. Contused wound.
36. ,, ,, forehead.
37. ,, ,, scalp.
38. ,, ,, forehead.
39. ,, ,, ,,
40. Cut.
41. Contused wound; scalp.
42. ,, ,,
43. ,, ,,
44. Lacerated wound.
45. Cut.
46. Lacerated wound; finger.
47. Contused wound.
48. Lacerated wound.
49. Contused wound.
51. ,, ,, eyebrow.
53. Lacerated wound.
56. Contused wound.

Case No. 59. Lacerated wound.
62. Amputation; fingers.
63. Contused wound.
65. Lacerated wound; finger.
66. ,, cut; ear.
68. Crushed hand.
69. Cut hand.
70. Contused wound.
71. Crushed finger.
72. ,, ,, amputation.
76. Contused wound; forehead.
82. ,, ,,
84. Cut hand.
85. Punctured wound.
88. Cut heel.
90. ,, ear.
91. ,, eyebrow.
93. ,, head.
95. ,, forehead; dirty.
96. ,, foot.
97. Crushed finger.
98. Cut hand.
99. Lacerated finger.
100. Cut scald.

Wounds already Septic.

Case No. 4. Contused wound, very septic; rapid cleaning.
5. Septic wound; head; cured in five days.
6. Septic finger; cured in three days.
18. Septic wound; scalp; cured in four days.
54. Abscess; foot; cured in five days.
55. Septic hand; satisfactory progress.
57. Septic wound; knee; satisfactory progress.
60. Abscess; healed in eight days.
64. Septic wound; foot; wound healing in nine days (irregular attendance).
67. Septic hand; cleaned in two days.
73. Septic foot; cleaned in two days.
74. Abscess; cleaned in two days.
75. Crushed toe; discharged healed in ten days.
77. Varicose ulcer; cleaned in three days.
78. Ulcer on leg; had tried everything; eupad cleaned in one day.
79. Lacerated wound; septic; cleaned in thirteen days (irregular attendance).
81. Abscess; knee; healed in four days.
83. Crushed finger; discharged healed in eleven days.
86. Septic thumb; cured in ten days.
87. Septic sore of three weeks' duration; satisfactory progress.
89. Cut scalp; seven inches; kick by horse; healed in seventeen days.
92. Whitlow; cured in fourteen days.
94. Spike wound; thigh; three inches deep; cured in five weeks.

ACCIDENTAL WOUNDS WHICH BECAME SEPTIC AFTER TREATMENT.

Case No. 1. Slight sepsis; patient missed seven days and came back septic.
14. Contused wound; dressing removed by patient.
17. Lacerated wound; slight sepsis.
32. ,, fingers; slight sepsis.
34. Contused wound; no dressing for three days.
50. ,, ,, three days no dressing; sepsis cured by one soak.
52. ,, ,, slight sepsis; dry dressing not sufficient.
58. Cut hand: slight sepsis; dry dressing not sufficient.
61. Contused wound; scalp; slight sepsis; dry dressing not sufficient.
80. Contused wound; scalp; no dressings for six days.

TABLE B.

MILITARY CASES.

The Military Hospital, Edinburgh Castle.

(See Note by Captain Beesly: Tabulation and Analysis of Special Cases, Section 2.)

Second Scottish General Hospital, Craigleith.

Captain W. J. Stuart.

No.	Age of wound	Nature of wound	Mode of application	Result
1	Recent	Large scalp wound infiltrated with road dirt	Freely washed and wet dressed	Healing by first intention.
2	,,	Large scalp wound infiltrated with road dirt	Freely washed and wet dressed	Healing by first intention except at one point.
		Captain Chiene.		
3	3 days	Sloughing muscle ..	Soak half strength, 1 per day	Clean; granulation in twenty days.
4	10 ,,	Bullet; gutter wound: thigh	Soak half strength, 1 per day	Sloughing wound; healed in three weeks.
5	9 ,,	Bullet wound; back: septic and sloughing	Soak half strength, 1 per day	Almost healed in four weeks.
6	10 ,,	Flesh wound; back; dirty, sloughing	Soak half strength, 1 per day	Wound sterile in eight days; healing rapidly.

Edinburgh War Hospital, Bangour.

Lieutenant-Colonel Cathcart. Dr. Laura K. Davies.

No.	Age of wound	Nature of wound	Mode of application	Result
7	26 days	Compound fracture of femur; septic and discharging	Soak and syringe, 3 per day	Wound sterile after thirty days.
8	8 ,,	Bullet: thigh; septic and discharging	Soak, 2 per day	Healed rapidly.
9	8 ,,	Shrapnel; arm; knee; two feet; septic and discharging	Soak, 2 per day	Wound sterile in nine days; healed up in thirteen days.
10	8 ,,	Shrapnel wounds; discharging	Soak, 2 per day	Healed up in eleven days.
11	6 ,,	Shrapnel; thigh; septic	Syringe and soak, 3 per day	Discharge was copious and fœtid; great improvement in general and local conditions in five days.
12	7 ,,	Bullet: arm: septic and discharging	Soak, 3 per day	Wound healing well in a fortnight.
13	8 ,,	Bullet: thigh; discharging	Soak, 2 per day	Steady and rapid improvement: nearly healed in twelve days.
14	8 ,,	Compound fracture humerus; comminuted; septic and discharging	Syringe and soak	Wound sterile in twenty-five days.
15	8 ,,	Bullet; leg; free discharge	Soak, 2 per day	Sterile in twenty-five days.
16	21 ,,	Compound fracture of femur; septic and discharging	Soak, 3 per day; syringe	Rapid bone union; discharge kept up by sequestra.
17	7 ,,	Deep punched-out shell wound: left thigh; septic and discharging	Syringe and soak, 3 per day	Marked improvement in nine days.
18	8 ,,	Bullet wound; back; septic and discharging	,, ,,	Discharge decreased; healing slow.
19	6 ,,	Gunshot; left shoulder and jaw; septic and discharging.	,, ,,	Rapid healing.

Captain Miles.

No.	Age of wound	Nature of wound	Mode of application	Result
20	92 days	Compound fracture tibia	Irrigation, 2 per day	Leg much swollen; copious discharge; discharge stopped in fifty days.
21	82 ,,	Compound fracture femur	Packing and irrigation	Copious discharge of pus; several pieces dead bone removed; wound healed thereafter in one month.
22	53 ,,	Compound fracture tibia: foul pus	Pack and syringe, 2 per day	Great improvement, but not ceased in seven weeks.
23	58 ,,	Compound fracture tibia; discharging green pus	Pack + eupad + syringe	Wound healed in five days.
24	55 ,,	Sinus: calf leg; foul discharge	Pack + eupad irrigation	Healed in seven days.

Royal Infirmary (Military Cases).

Major Hodsdon. Mr. Wood.

No.	Age of wound	Nature of wound	Mode of application	Result
25	21 days	Amputation on hospital ship; gangrenous amputation flaps	Dry dressing, 1 per day	Stump healed in seven weeks.
26	10 ,,	Compound comminuted fracture; elbow	Syringe and wet dress, 1 per day	Healed very rapidly after operation.
27	10 ,,	Compound fracture of ulna	Syringe and wet dress, 1 per day	Practically healed in one month.
28	9 ,,	Shell splinters in hand	Syringe and wet dress, 1 per day	Healed in fifteen days.
29	9 ,,	Compound fracture femur	Syringe and wet dress, 2 per day	Sequestrum removed; healed in five weeks.
		Captain Miles.		
30	6 days	Septic bullet wound; forearm	Eusol and hot fomentations	Wound healed satisfactorily.
31	7 ,,	Bullet wounds; back and legs	Eusol soaks and spray	Both wounds discharging freely; cleaned up rapidly.
32	30 ,,	Amputation stump thigh	Soaks	The stump had been left conical on account of septic condition of leg; very septic on admission; cleaned very satisfactorily with eusol.
		Mr. Alexander.		
33	16 days	Septic ulcer; hand	Soak, half strength, 1 per day	Healed rapidly.
34	16 ,,	Bullet wound; thigh; septic	Soak, half strength, then full strength	Rapid healing.
35	16 ,,	Perforating; foot; septic	Soak, half strength	Painless healing.
36	18 ,,	Amputation flaps; knee; septic	Soak, half strength	Rapid granulation.
37	16 ,,	Bullet wound; septic	Soak, half strength	Satisfactory.
38	16 ,,	Bullet wound; septic	Soak, half strength	,,

Deaconess Hospital.

Captain Stuart. Dr. Andrew Rutherford.

No.	Age of wound	Nature of wound	Mode of application	Result
39	16 days	Shrapnel wound; foot; very septic	Soak, 2 per day	Wound sterile in twenty days; discharged in one month.
40	16 ,,	Amputation flaps; thigh	Soak; flooded every four hours	Fœtid pus; flaps sterile in twenty days; very rapid healing.

Dalmeny House Hospital.

Major Wallace. Dr. Bennet Clark.

No.	Age of wounds	Nature of wound	Mode of application	Result
41	17 days	Large superficial wound; leg	Four-hourly soak	In eighteen days skin-grafting successful; practically healed sixteen days later.
42	81 ,,	Septic amputation flaps; leg	,, ,,	Discharge practically ceased and rapid healing in eight days.
43	48 ,,	Foul superficial wound; right shoulder	,, ,,	Discharge stopped and rapidly healing in ten days.
44	16 ,,	Compound comminuted fracture of clavicle; deep wound	Four-hourly soak + eupad once in twenty-four hours	Wound healed in one month; small fragments of bone frequently discharged throughout the month.
45	10 ,,	Deep ragged bullet wound; forearm	Irrigation and four-hourly soak	Discharge ceased in ten days.
46	135 ,,	Sinus; dead bone; operation for sequestrum	Syringing twice daily	Rapid healing.
47	48 ,,	Compound comminuted fracture of humerus	Syringing twice daily	Discharge ceased altogether; wound dry and healed in five days.
48	17 ,,	Sinus; upper arm	Soaks fourteen days no good; syringe twice daily; good in twenty - four hours	Practically healed in three days after change of method.
49	48 ,,	Compound fracture shoulder (scapula)	Four-hourly soak	Discharge after seven days almost negligible; wound closing in eleven days.
50	Special case	Chronic osteomyelitis	Irrigated for fourteen days	After fourteen days' irrigation wound was quite clean and stimulating dressings were then adopted.
51	Special case	Sequestrum of tibia (operation)	Irrigation and dry dressing, 2 per day	Wound healed from the bottom without packing in one month.
52	10 days	Foul lacerated superficial wound of arm	Four-hourly soak	Skin-grafting after eight days; eusol very succesful.
53	10 ,,	Sinus; calf of leg ..	Irrigation, 2 per day	Discharge much less in two days; slough separating fast; healed in three weeks.
54	11 ,,	Two sinuses; chest and shoulder; bullet wound	Irrigation, 2 per day	Slough cleaned up in one week after eusol; exit wound healed in three weeks.

Victoria Red Cross Hospital.
Dr. R. W. Johnstone.

No.	Age of wound	Nature of wound	Mode of application	Result
55	..	Old ulcer on neck ..	Irrigation, 1 per day	Sterile in eight days.
56	19 days	Four superficial shrapnel wounds	Irrigation, 1 per day	Healed in one week.
57	8 months	Compound fracture femur; six operations	Irrigation and packing	Sinuses healed in six weeks.
58	3 ,,	Compound comminuted fracture foot	Irrigation and packing	Wound cleaned; serous discharge persisted.

Tabulation and Analysis of Special Cases.

The cases recorded in the tables may be classified under the following headings:—

(1) Recent accidental wounds.
(2) Wounds already septic:—
 (*a*) Superficial.
 (*b*) Deep flesh wounds with or without foreign bodies.
 (*c*) Compound fractures, with splintering, necrosis, etc.
(3) Conditions in serous and synovial cavities.
(4) Conditions on mucous surfaces.
(5) Inflammatory lesions:—
 (*a*) Cellulitis.
 (*b*) Abscess.
 (*c*) Amputation through septic tissues.
 (*d*) Arthritis with mixed infection; amputation.
 (*e*) Tuberculous bones.
(6) Skin infections.
(7) Operations for carcinoma:—
 (*a*) Rectum.
 (*b*) Mamma.

The records of the civil cases include acute appendicitis, operations for carcinoma of rectum and mamma, varicose ulcer, tuberculous lesions, cellulitis and abscess from micrococcal infection, necrosis of bone, necrosis of scalp from contusion, specific ulcers, cystitis, and gonorrhœal urethritis. There is also a series treated in the surgical out-patient department of the Royal Infirmary, and other recent accidental wounds.

A special list of cases treated in the Ear and Throat Department of the Royal Infirmary has been included.

In addition there is a series from the Longmore Hospital for

Incurables, showing the extent to which eusol has been applied in the alleviation of chronic discharges and the elimination of fœtor.

The records from Military Hospitals include the following :—

Superficial wounds ; deep flesh wounds ; fractures and injury to bone, including necrosis ; septic synovitis.

The wounds were all septic when the patients reached the hospitals. Except in a few cases of recent accidental wounds, the interval between the receipt of the wound and entry to hospital varied from one to three weeks ; in many cases the interval was longer, treatment having already been carried out in another hospital.

(1) *Recent Accidental Wounds.*

Cases tabulated from the Surgical Out-patient Department, Royal Infirmary, show that eighty-six per cent of recent wounds remained aseptic. This result was obtained by means of free application of eusol before dressing. A dressing of gauze soaked in eusol was applied over the wound after stitching and in a few cases this was covered with jaconet. As a rule, however, the dry dressing was sufficient to keep the wound aseptic.

It has been noted that in the treatment of small wounds where there is every probability of sepsis, it is a good plan to apply a eusol soak for the first twenty-four hours, i.e., before stitching, and thereafter a dry dressing. This renders drainage unnecessary.

Of the cases that became septic (ten per cent) this was as a rule due to the fact that the patient did not return when directed or interfered with the dressing. One or two of the cases became slightly septic during treatment. This occurred, however, before the value of preliminary treatment in certain cases with soaks had been realized.

Mr. Jardine and Lieutenant Cameron's Case.

Case A, 47.—Case of street accident. The patient had been knocked down by a tramcar and the street dirt had been ground into the interior of a scalp wound four and a half inches long. The tissues were quite black and it was impossible to remove the dirt by sponging. The gross dirt was cut away and the wound and surrounding parts were thoroughly sponged with eusol, the wound was then packed with gauze impregnated with eusol and a eusol soak was applied over the surface. The wound was not stitched as it was so dirty. Twenty-four hours later when the packing was removed the wound was clean enough for partial stitching. The slight discharge of pus entirely ceased in five days and nine days later patient was discharged cured.

Captain Stuart's Cases.

Case B, 1.—Motor-car accident, overturning on hard country road. Large antero-posterior scalp wound from anterior margin of hair almost

to external occipital protuberance, much undermining of flaps, extending on one side to base of mastoid, part of pericranium being torn away, with exposure of bone. There was a second scalp wound about four inches long on the other side of the scalp, also much undermined. There was much infiltration of the deep surface of the scalp flaps and of the pericranium with road dust. Wounds were thoroughly washed out with eusol and dirty tags were cut away, but it was impossible to remove the dirt completely. Gauze swabs soaked in eusol were laid under the scalp flaps and left there while the scalp was being shaved and painted with iodine, no iodine was put on the wound edges nor into the wound. The smaller wound was closed without drainage, the larger one was completely closed, but a small tube was introduced into the cavity through a stab opening above the ear. Both wounds healed by first intention without a sign of sepsis.

Case B, 2.—Same accident as B, 1. Antero-posterior wound of scalp beginning close above the right eye, passing through the eyebrow, up the forehead and backwards to rather beyond the level of the external occipital protuberance. The lateral flap of the scalp had been raised as in the previous case down to the mastoid. There was another long wound on the left side of the scalp with undermined edges, and a small wound farther back. Pericranium was exposed and parts of it torn away. There was not much road dirt in the wounds. The case was dealt with in precisely the same way as B, 1. All the wounds were stitched up completely, but small pieces of tubing were introduced through stab openings into the large wound. All healed by first intention with the exception of a small circumscribed area in front of the ear: a small abscess formed and was incised.

Captain Stiles's Case.

Case A, 9.—Septic burn of thorax: An extensive superficial burn of the thorax, of two weeks' duration, was dressed twice daily with eusol. On admission the ulcer was dirty, covered with large greyish-yellow sloughs and showed no sign of healing. Within five days the sloughs had entirely separated, leaving a healthy granulating surface, dotted here and there with islands of epithelium. The granulations, after another two days, became so vascular that the eusol dressings were stopped and boracic substituted. The child was discharged seven days after admission and treated as an out-patient. There is no doubt that the eusol cleaned up and stimulated the burn with greater rapidity than any other antiseptic used here (Royal Hospital for Sick Children, Edinburgh).

Mr. J. M. Graham's Cases.

Case A, 94.—Case of partial avulsion of scalp treated by eusol: The patient, a boy, aged 4, was knocked over by a motor-car on November 29, 1915. He was dragged for a considerable distance: brought into hospital

unconscious. It was then found that the scalp was cut to the bone transversely from ear to ear and the posterior portion was completely separated from the cranium. Much dirt was ground into the edges of the wound, into the under surface of the flap and also into the surface of the bones of the skull, which were exposed. Three hours after the injury the patient had recovered consciousness, and under a general anæsthetic the scalp and exposed parts were cleansed with eusol. Portions of dirt were removed with forceps and by clipping the tissues with scissors. The parts were sponged with gauze soaked in eusol and the latter was freely used to wash out the recesses of the wound. After thorough cleansing, the wound was completely stitched up after the insertion of two small drainage-tubes at dependent points. The wound healed by first intention: no suppuration occurred.

Case A, 95.—Case of severe laceration of right arm requiring amputation: The patient, a boy, aged 15, fell off a railway engine, a wheel passing over his right arm. The patient was seen in hospital four hours after his injury, a tourniquet which was applied at the time of the accident still being in position. The skin, muscles and other tissues about the elbow were much torn, and the raw surfaces were engrained with dirt: the lower third of the humerus was comminuted and the elbow-joint dislocated. The skin was completely stripped off the muscles as far as the shoulder-joint. An anæsthetic was administered and a circular amputation performed through the middle of the upper arm: the skin and the wound having first been thoroughly washed with swabs soaked in eusol. The stump healed by first intention.

Case A, 96.—Patient was a man aged 60. Both hands were crushed by the wheels of a light engine. Condition on admission: Very collapsed; severe shock. The left hand was practically reduced to pulp and was only connected to the arm by a confused mass of torn tendons. The right hand was severely damaged; thumb missing; all the fingers crushed and metacarpal bones broken, except that of the little finger. Part of the skin of the palm was intact. Right hand—four hours after accident: careful cleansing with eusol; damaged parts removed; tendons stitched over carpus and flaps sutured in position; base of the thumb and entire little finger saved. Left hand—amputation was necessary above the wrist; parts thoroughly irrigated with eusol; raw surfaces were black with dirt; saline enemata. After progress: right hand—healed by first intention, with the exception of a little necrosis at the line of suture. Left hand—a considerable slough formed at the apex of the dorsal flap, owing to lack of vitality in the skin. This was associated with slight sepsis which disappeared with the removal of the slough.

Case A, 97.—Patient was a man aged 69. Case of compound comminuted fracture of elbow region. Admitted one and three-quarter hours after the accident: knocked down by passing goods train, four waggons passing over his elbow. Condition on admission: Considerable shock;

subnormal temperature, 95° F. One large wound, three inches long and two inches broad, was situated in front of and above the head of the radius. There were several smaller wounds and much general bruising of the arm. The raw surface was engrained with dirt. There was a compound, much comminuted, fracture of the lower end of the humerus. As the radial pulse was good and there was no evidence of destruction of nerves, it was decided to try to save the arm. The wound was thoroughly irrigated with eusol and packed with swabs wrung out of eusol. The arm was laid on a pillow with the intention of securing ankylosis. The skiagram showed a comminuted fracture of all the bones entering into the elbow-joint. After progress: A large amount of muscle and some skin sloughed during the first week. A slight amount of suppuration was present and numerous fragments of bone were removed. The patient is still under treatment, having just had a large sequestrum removed. On the whole the result has been very satisfactory, as the patient has now considerable power of movement at the elbow-joint. Considering the severe nature of the injury it was doubtful at the time whether the arm could be saved at all.

(2) *Wounds already Septic.*

Where septic processes are already present in the wound the treatment has usually been carried out by means of syringing and soaks or baths.

The aim is, in the first place, to eliminate sepsis. If it be necessary for this purpose to apply eusol every four hours, a drainage-tube should be inserted and so arranged that it can be used as a channel for irrigating the wound with a minimum disturbance of the dressings. In a septic cavity the antiseptic, warmed to body temperature, should be brought into contact with all the recesses and applied as freely as possible to the whole of the infected area. Hypochlorous acid forms a compound with the albuminous substances in the exudate and is thereby decomposed, but the compound is itself an antiseptic. To secure the elimination of sepsis it is important, therefore, to flush the cavity freely.

The eusol brings about separation of the sloughs and formation of a covering of granulation tissue over the raw surface. A minimal amount of discharge remains consisting of serous fluid, and this can be absorbed by a loose packing of gauze soaked in eusol: the wound is thereby kept sufficiently dry while healing proceeds.

Where a tube is combined with the gauze the tube should be removed once and the gauze at least twice in twenty-four hours in the earlier stages of the treatment.

It has been found beneficial in some cases to change the treatment after granulations have formed. Eusol may be alternated with another form of dressing, or it may be discontinued when the sepsis is under control. Any tendency to exuberant growth of granulations and delay

in healing can be counteracted in various ways indicated in the notes on the cases.

While the cases recorded are sufficient to indicate the general principles involved in the treatment of wound by eusol, further experience is required to determine the methods appropriate to wounds of a special or unusual character.

Major Hodsdon and Mr. Wood's Cases.

Case B, 26.—A sailor had both legs injured by shell-fire, and amputation of the right was performed. When the patient reached Edinburgh Royal Infirmary the flaps covering the stump had become gangrenous and sloughing: there was a foul discharge. Washing and dry dressing with eusol for thirteen days cleaned up the surface and skin-grafting was successfully carried out.

In the following four cases the patients were wounded on September 25 and admitted to the Royal Infirmary on October 5.

Case B, 25.—A very severe case of compound fracture of the arm with splintering of the lower third of the humerus and upper third of the radius and ulna: copious purulent discharge; after the wound had been opened up to allow free drainage and application of eusol, the arm healed rapidly and the patient's general condition improved markedly. The discharge had practically ceased in nineteen days.

Case B, 27.—Case of compound fracture of both bones of forearm: two large, gaping wounds; copious offensive discharge; lower part of ulna completely shattered. The wound was treated by syringing and wet dressing once daily. In five days the wound was much cleaner and in four weeks both wounds were in the condition of a healthy sore. The wound cleaned up remarkably well.

Case B, 28.—Case of bullet wound in palm of right hand; very dirty and discharging pus freely; the hand was swollen and inflamed. It was treated by syringing and wet dressing once daily and in nine days the wound was almost clean. Eusol cleaned up this case and reduced the amount of discharge very quickly. Numerous splinters of shrapnel had to be removed. Apart from this the wound was completely healed in a fortnight.

Case B, 29.—Case of compound fracture of left femur: wound through thigh was very septic and foul-smelling; a large cavity was present in connection with the exit wound. The wound was syringed and wet dressed twice daily. There was distinct improvement in six days. Nine days after this a large sequestrum was removed, and thirteen days later a piece of shrapnel was removed and another piece five days later. The wound healed up rapidly and the bones became quite firm.

Major Wallace and Dr. Bennet Clark's Cases.

Case B, 48.—Case of shrapnel wound of the upper arm; sinus about two inches long, which was not healing. It was seventeen days old. The sinus was treated for fourteen days with eusol soaks every four hours. At the end of this time treatment was changed to syringing and dry dressing twice daily. Under the latter treatment it healed in six days. This case exemplifies the fact that the mode of application of eusol is highly important, and that it must be directly applied to the infected surface.

Case B, 52.—Case of large superficial lacerated wound of the forearm, covered with sloughs, discharging profusely; pus thick and foul-smelling. It was treated with eusol soaks, four-hourly, and was sufficiently clean for skin-grafting in eight days; it was completely healed a fortnight later. This was considered a very successful case.

Case B, 43.—Case of superficial shrapnel wound of forty-eight days' standing: it was situated in the shoulder and was very foul. Eusol soaks applied every four hours cleaned the wound, and it was healing rapidly after ten days.

Dr. R. W. Johnstone's Case.

Case B, 57.—Case of compound fracture of the femur. There had been six operations during a period of eight months. At the time when eusol treatment was commenced there were two septic sinuses each four inches deep leading down to the femur, and it was suspected at first that dead bone was present. The sinuses were irrigated with eusol twice daily and lightly packed with worsted soaked in eusol. The sinuses healed in six weeks. The record continues: "In view of the long history of sepsis this is a remarkably satisfactory result. Patient was discharged for light duty."

Captain J. W. Stuart and Dr. Andrew Rutherford's Case.

Case B, 40.—Case of shrapnel wound of the foot: amputation through the thigh because of rapidly spreading gangrene. When patient reached the Deaconess Hospital the stitches had burst, the flaps having given way and receded for a considerable distance, leaving the stump of the bone exposed; the surface of the flaps was bathed in pus and emitted a fœtid odour. It was treated with soaks twice daily, and eusol was poured into the dressing every four hours by a tube which had been inserted for the purpose. The surface of the wound became healthy and the end of the bone became covered with healthy granulations. It was originally intended to remove some of the bone and make new flaps, but this was found unnecessary.

Note by Lieutenant-Colonel Caird.

"Military Cases—gunshot and shrapnel wounds: Fifteen cases admitted seven to ten days after receipt of injury, all septic and suppurating, progressed in a satisfactory manner. None had rise of pulse or temperature, and all healed well, although three were very slow. One case proved fatal where an operation to remove a small sequestrum from the tibia was followed by an acute septicæmia and endocarditis, which carried off the patient on the eighteenth day." The post-mortem examination showed chronic and acute endocarditis of the aortic valve, septic thrombosis of the femoral vein, and infarction of the spleen.

"One case, a disarticulation at the knee-joint, with retracted flaps and protruding extremity of femur, was admitted seventeen days after operation. The wound was sloughy; temperature 102° F.; pulse 120. Eusol dressing applied August 10. Temperature normal; wound granulating and pulse normal August 20. Healing thereafter promoted by change of dressing and epithelial grafting."

Note by Captain Stiles.

"I may say that I have used eusol in many other cases besides those referred to in the tables. The conclusions I have come to are that eusol is the most efficient antiseptic we possess in the treatment of the lacerated and contused wounds and compound fractures such as are met with in military practice. It brings about the rapid separation of the sloughs, and healthy granulations form more rapidly than under the use of any other antiseptic; its continued use causes an excessive growth of very vascular granulations, so that bleeding from them is more severe than usual. During the later stages of the treatment, therefore, it is advisable to substitute either hypertonic salt solution or boracic for the eusol."

Captain A. A. Scott Skirving

writes that he has employed eusol in several hundred cases in Craigleith and Bangour military hospitals and in civil practice. His experience has been such as to lead him to order it as a routine treatment in every case where an open wound existed, and the results obtained have justified its use.

Note by Captain Beesly (Surgeon Specialist, the Military Hospital, Edinburgh).

"The only cases in which there has been a suitable opportunity for testing thoroughly the value of eusol in the Military Hospital, Edinburgh, have been those of chronic localized sepsis of bones usually associated with cavities and sequestra. Such cases have been plentiful, and the eight months which have elapsed since the treatment described below was first begun have allowed time for a definite opinion to be formed regarding the advantages possessed by eusol.

"Many of the patients under consideration had had four or five previous

operations, and as far as could be made out the recurrences were due to healing of the superficial soft structures before the underlying bone had healed.

"In view of this, the following method was adopted: The area dealt with was widely opened up, the sequestra removed, and the cavity or cavities bevelled away as flat as the security to the shaft of the bone permitted. Thereafter the area was kept wide open and the cavity down to the bone, lined with a sheet of perforated green protective, was packed with iodoform gauze to keep it fresh and to control the oozing. This dressing was not changed for three days.

"This primary iodoform dressing was found more satisfactory than gauze soaked in eusol, as the latter required to be changed daily. The subsequent dressings carried out daily comprised washing the area thoroughly with warm eusol (0·5 per cent. hypochlorous acid) and packing it in the same manner as before, but with gauze soaked in eusol.

"By this method the area was kept permanently clean, the serous discharge reduced to a minimum and the granulation tissue never became vegetative.

"It was noticed that eusol could be applied continuously in the prolonged treatment necessary for the closure of these large open wounds, whereas other applications could not be so used and required to be alternated with each other.

"A distinct advantage of the eusol dressing is the marked reduction of the serous exudate. This allows the deeper parts of the wound to be lightly packed and the superficial area to be firmly packed, there being no question as to obstructing the outflow of the discharge.

"In this way the superficial tissues are kept widely separated, and the deeply seated wound in the bone can be observed healing. The very slight amount of serous discharge which occurs readily passes through the perforated green protective, and is absorbed by the eusol gauze, which, however, never becomes sodden, and in no case thus treated was there trouble from hæmorrhage or overgrowth of granulations.

"There has been little opportunity of testing the value of eusol in acute suppurative cases, but in a few patients with gangrenous appendicitis it was noted that the period of drainage and pus discharge was much curtailed when the area was thoroughly cleansed with eusol.

"In three such cases the tubes were removed upon the third day and all discharge had ceased by the sixth day. These patients left hospital completely healed in twenty-one days."

(3) *Serous and Synovial Cavities.*

Note by Lieutenant-Colonel Caird.

"Cases of extravasation of urine and gangrenous appendicitis with fæcal fistula; temperature was reduced and sepsis controlled on being treated with eusol."

Mr. W. Q. Wood's Case.

Case A, 89.—"Case of perforated gangrenous appendix. The patient was very collapsed on admission; temperature 100° F., pulse 132. She had been ill for five days. Immediate operation. Patient had general peritonitis with foul-smelling pus and a quantity of free gas throughout the lower part of the abdomen. The abdomen was freely douched out with eusol. Patient made an uninterrupted recovery. This case demonstrates the fact that eusol can be employed in the peritoneal cavity with the greatest safety."

Note by Captain Stiles.

"In the Hospital for Sick Children the method of treatment in cases of appendicitis is to irrigate the drainage tracks freely twice daily two days after the operation. Formerly peroxide of hydrogen was used for this purpose; better results, however, have been obtained by application of eusol, and the patients are discharged about a week earlier than was previously the case."

Note by Captain Stuart.

"*Appendix cases:* I have employed eusol during the last seven months in fourteen cases of acute appendicitis, where the appendix was gangrenous and perforated, with offensive pus round it. In all cases the peritoneal cavity was necessarily opened, the appendix was removed and a rubber tube left in the lateral wound, while a glass tube was introduced to the bottom of the pelvis through a suprapubic opening. The glass tube was almost invariably removed on the second or third day, and the rubber tube gradually shortened till healing occurred. In the early cases no eusol was employed at the operation. The cases in question all behaved in very much the same way. There was a fairly profuse, very offensive discharge from the lateral tube, and on about the fourth or fifth day the larger rubber tube having been taken out, a small one was passed down to the bottom of the wound, and about half a pint of eusol syringed down the tube, so as to well out by the side of it, the larger tube being again replaced. In a few cases this was done twice daily for two or three days, and then once daily; in most of the cases only one daily dressing was performed from the first. As a rule in two to four days the smell had practically disappeared, the infection disappearing with a rapidity which I have not seen under any other treatment. When the sinus became practically aseptic, the use of eusol was stopped, otherwise healing was delayed.

"In the last two or three cases I have at the operation swabbed out the region of the appendix with slightly warmed, and therefore slightly dilute, eusol, and poured it through the lateral wound down into the pelvis. This eusol was sucked out again through the suprapubic tube at the close of the operation. I have not yet done this often enough to

form an opinion regarding it, but in these very few cases I think that the discharge afterwards was less profuse and less offensive, though asepsis was not secured."

Note by Captain Stiles.

"*Empyema:* In my experience empyemas do well if they are opened early, and if a large enough opening is made to enable the fibrinous masses to be removed. If this is done there is usually no need to keep the tube in more than a few days. The main point, however, in the after-treatment is the prevention of mixed infection. This is best effected by the application of a large eusol dressing, which should be changed daily. And this leads me to say that I have met with no cases in which any irritation of the skin has resulted. While I have not thought it necessary to douche out the pleural cavity at the operation, I have found that in old-standing fœtid empyemas the best results are to be got by free irrigation with eusol, as by this means the fœtor is more rapidly controlled than by the use of any other antiseptic, and the fever is at the same time more effectively reduced."

Major Hodsdon's Case.

"*Streptococcal synovitis:* Patient was wounded in the left leg in Gallipoli on October 25. A bullet was removed from the leg on November 8 on board a hospital ship. When the patient was admitted into the Royal Infirmary on November 16 there were three large suppurating wounds in the calf. An abscess over the internal malleolus was opened on November 24; on November 26 the temperature was 102° to 103° F.; pulse 120 to 125. There was effusion into the knee-joint. This was aspirated on the following day; sero-purulent fluid (which gave a pure culture of streptococci) was drawn off and two ounces of eusol injected into the joint. The knee improved during the next twenty-four hours. On November 30 the temperature was 102° F., pulse 112 to 124; the joint tightly distended and very tender to touch. The patient was extremely ill and toxic in appearance. Under general anæsthesia the effusion, which was now purulent (and still gave a pure culture of streptococci), was removed by aspiration, the joint washed out with eusol and freely moved until the fluid which returned was clear: finally the synovial cavity was distended with eusol, the puncture being closed by a clip to prevent escape of the antiseptic.

"The following day the general and local conditions showed marked improvement, and the joint was painless to touch. The temperature however, remained at 101° to 102° F., pulse 112 to 118, until December 3, when a collection of pus was evacuated from the lower third of the thigh. Two days later the temperature was normal, pulse 108; the joint condition had completely subsided, and passive movement was painless."

(4) *Mucous Surfaces.*

In acutely inflamed mucous surfaces the application of eusol may produce pain and discomfort. On the other hand, in chronic inflammation even the full strength can be easily borne. In the tables only a few cases are recorded of application to mucous surfaces. In cases of cystitis or colitis the eusol for the first application may be diluted with warm normal saline to one in ten, but it will be found that the patient can soon tolerate a much greater concentration.

Lieutenant-Colonel Caird's Case.

"Suprapubic removal of extensive papillomata of bladder; great hæmaturia; foul urine.

"On the day after operation the temperature rose to 100° F., the pulse to 120, and the following day the patient looked very ill. The bladder was washed out with eusol and at night the temperature was normal and the pulse had fallen to 112. Subsequent progress satisfactory."

(5) *Inflammatory Lesions.*

(*a*) Cellulitis.

Captain Stiles's Case.

Case A, 36.—"Patient was a nurse who had a whitlow of the thumb. She was very ill, with a temperature of 104° F., and a suppurative condition extending along the long flexor of the thumb into the forearm. There was marked œdema of the thumb with swelling and tenderness of the axillary glands. A free incision was made in the palm and another longer one in the forearm down on to the flexor longus pollicis tendon. The limb was then placed in a eusol bath for two hours twice daily and in the intervals a boracic bath was substituted. The fever disappeared in a few days, the œdema quickly subsided, and the wound rapidly became covered with healthy granulations."

(*b*) Abscess—see Cases A, 25 and 26.

(*c*) Amputation through septic tissues.

Note by Captain Stiles.

"In performing these amputations I have been gratified to find that by douching the flaps very freely with eusol and applying eusol dressings, very frequently the healing has been almost as rapid as in an aseptic amputation."

While the report does not include cases of amputation for "gas gangrene" the Committee may be permitted to refer to the results obtained by Captain John Fraser in the field, an account of which was published in the *British Medical Journal* on October 9, 1915. He showed that by the application of eusol he was enabled to amputate successfully through infected tissue.

(*d*) Arthritis with mixed infection, amputation.

Captain Stiles's Case.

Case A, 24.—"This was a case of very advanced hip-joint disease with extensive involvement of the acetabulum and septic sinuses. At the operation the sinuses were dissected away as far as possible, and after thoroughly irrigating the wound with eusol, eupad was freely applied to the curetted acetabulum and to the unhealthy tissues round about the sinuses. The child's condition improved very quickly, and I am satisfied that the healing process was more rapid than I had been accustomed to see in similar cases which had not been treated with eusol.

"The beneficial action of eusol was even more strikingly shown in another amputation of the hip-joint in a child who had suffered from severe osteomyelitis of the shaft of the femur with secondary involvement of the hip-joint. The flaps healed practically by first intention and the child, who was almost moribund at the time, put on weight with great rapidity, and is now, eight weeks after the operation, in robust health. No doubt the removal of the septic area accounted for the child's recovery, but the eusol, in my opinion, certainly added greatly to the rapidity and completeness of the convalescence."

(*e*) Tuberculosis of bones.

Note by Captain Stiles.

"After removing the tuberculous focus it has been my practice recently to apply eupad freely to the cavity which has been left, using it as a substitute for sublimated iodoform bismuth paste. I have also applied it freely to the curetted acetabulum after excising the hip for tuberculous disease. I have then stitched the muscles over the trochanter and closed the wound without drainage. The eupad did not appear to produce any pain or irritation. Healing by first intention resulted, but the same has occurred after the application of sublimated iodoform bismuth paste."

(6) *Skin Infection.*

Dr. J. W. Crerar's Case.

"Cases of coccogenic sycosis (Unna) treated with eupad. On September 20, Lieutenant S. presented himself with extensive pustular eruption of chin, cheeks and neck, the pustules closely aggregated on chin, especially just below lower lip, discrete on cheeks and neck.

"A paste of eupad and water was thoroughly rubbed into the whole infected area and left in contact for fifteen minutes. This was washed off, and an indifferent bland ointment was ordered.

"On September 22 (two days later), close examination with a lens revealed only three small pustules on the neck. To these a paste of eupad was applied.

"On September 24 (two days later) three fresh pustules were seen, and similarly treated; no others to be seen.

"On September 27 (three days later) careful examination failed to reveal a single pustule. Cheeks and neck were normal, and the only sign of the condition was slight (non-pustular) excoriation below the lower lip. Treatment completely cured the condition within one week. Cultures from a pustule gave a growth of *Staphylococcus pyogenes aureus*.

"For application of eupad in this manner it is advisable to place a pad of gauze moistened with solution of sodium hyposulphite over mouth and nose to prevent respiratory irritation from the hypochlorous acid gas."

(7) *Operations for Carcinoma.*

(*a*) Rectum.

Major Hodsdon and Mr. Wood's Case.

Case A, 5.—"A feeble man, aged 68: colostomy on August 15; lower part of rectum and anal canal excised under spinal anæsthesia on August 26; wound packed with iodoform gauze. On the evening of the 26th the temperature was 99° F., and pulse 120. On the morning of the 27th the wound was sloughy and the discharge very fœtid; temperature 98·4° F., pulse 124. The wound was syringed out with eusol and packed with gauze dusted with eupad. That night the pulse-rate fell to 88, and subsequently never exceeded 96. The fœtor rapidly diminished; the wound was granulating on the third day, and healing satisfactorily. The eupad packing was discontinued on August 30; the syringing once daily with eusol continued until September 20."

Captain Stiles's Case.

Case A, 6.—"The wound was that of a large carcinoma of the rectum just within reach of the finger. A preliminary colostomy was first performed, and the rectum excised a few weeks later by the sacral route. The wound healed by first intention, and the drainage openings were completely closed at the end of the fifth week. I attribute the absence of fever after the operation, the general well-being of the patient, and the rapid healing, mainly to the closure of the end of the divided bowel, but partly also to the daily irrigation with eusol of the large cavity left in the pelvis. Experience of rectal cases suggests the value of eusol in inoperable cases of carcinoma of the rectum after colostomy; also as a vaginal douche in inoperable cases of carcinoma of the cervix uteri and other septic conditions about the female genital passages."

(*b*) Operation for carcinoma of the mamma.

Lieutenant-Colonel Caird's Case.

"Markedly septic case with foul odour. Huge fungating carcinoma of the mamma. Removal complete with glands.

"On the seventh day the discharge became very offensive and penetrating; eusol dressings were applied twice daily. On the second dressing all odour had gone, the discharge diminished, and had practically ceased at the end of a week. Patient up on seventh day. Wound stationary for a time; a change to boric acid and red lotion at once hastened healing. Throughout the patient had no elevation of temperature or rise of pulse."

General Conclusion.

Further clinical experience of eusol in a great variety of cases has proved it to be a non-toxic, non-irritating and efficient antiseptic.

Nothing in this experience has been more striking than the fact that while it is highly destructive to bacteria it is non-toxic to the tissues. In eusol free hypochlorous acid is the most essential ingredient, but there is present also a sufficient quantity of bi-borate of calcium to give the solution a reaction alkaline to litmus. This feebly alkaline solution can be introduced into wounds or serous cavities with perfect safety. It can even be left in such cavities in quantity without any harmful effect. In lacerated and contused wounds, and in compound fractures such as are met with in military practice, it is the most efficient antiseptic we possess.

It is most efficacious during the period of what might be termed progressive sepsis. Some surgeons have emphasized the benefit of modifying the treatment when sepsis is subsiding, or has ceased. The granulations form after a period of two to three days, and rapidly cover the surface of the wound. Any tendency to superabundant growth of granulations and consequent delay in healing can be counteracted either by so applying the eusol that the serous discharge is reduced to a minimum and the wound is kept dry, or by discontinuing eusol and using other dressings appropriate for healing wounds. In any event the sepsis is by this stage completely under control.

The freedom which can be exercised in the application of eusol, and the rapid action which it has in arresting the sepsis and discharge of an infected wound, led to experiments on the effect of eusol on the blood. Following on this eusol was employed in the treatment of general septic toxæmia by intravenous injection.

This method was first made use of by Lorrain Smith, Ritchie and Rettie,[1] in a case of grave puerperal septicæmia, and the result was the recovery of the patient. They have applied the treatment in other similar conditions. In several cases toxæmia has been successfully overcome, and although such a result has not been uniformly attained the safety of the method justifies its being applied to the diseases referred to in their preliminary communication. Intravenous injection has also been applied

[1] *British Medical Journal*, November 13, 1915.

with success by Captain Fraser and Captain Bates in cases of acute toxæmia secondary to gas gangrene.[1] Further research is now being carried out on the development of the subject foreshadowed by these investigations.

On behalf of the Committee,
(Signed) JAMES HODSDON.

APPENDIX.

Some practical considerations remain. Hypochlorous acid is an extremely active bleaching agent, and it should therefore not be brought into contact with coloured fabrics. Further, if cloth is kept in the solution for some time its fibres are made brittle from destruction of the texture. Any towels, etc., which become wetted by the lotion should be forthwith rinsed in a large quantity of water to remove the acid as rapidly as may be. It also is corrosive to metals; instruments, needles, etc., should be carefully treated, else they will rust.

The lotion is exceedingly inexpensive. The ingredients are procurable everywhere at a slight cost and the preparation is a very simple process. At the present time, especially, it will be found that the introduction of eusol will effect economy in the outlay for the treatment of septic wounds, a point of considerable importance since phenol and its derivatives are becoming increasingly difficult to procure.

Finally, it may be useful to set forth the details for preparing the antiseptic. Eupad powder is composed of equal weights of boric acid and bleaching powder. The boric acid is in sufficient excess to set free the hypochlorous acid in the solution. The bleaching powder should be dry and should contain twenty-eight to thirty per cent available chlorine.

The solution eusol is prepared as follows: Add to one litre of water twenty-five grammes of the powder; shake well; allow it to stand an hour; filter. The clear solution is eusol and contains about 0·5 per cent hypochlorous acid. If the bleaching powder is old or not up to the strength given above, use a larger quantity of the powder.

A rough-and-ready method of preparation is to add half an ounce of the mixed powder to one pint of water, stir or shake, and allow the sediment to settle. In cold weather the solution will keep its strength for three weeks. In hot summer weather it loses its strength more rapidly and should not be kept more than one week. It keeps best in bottles of *coloured glass* in a dark cupboard.

For use as a lotion the *solution must be warmed.* This may be done by placing the bottle in a basin of hot water, or the solution may be made double strength (fifty grammes to the litre) and diluted with an equal volume of hot water. The double strength solution will not keep its value for more than two days.

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[1] *British Medical Journal*, January 15, 1916.

Review.

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VOLUME XXVI. APRIL, 1916. No. 4.

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By TEMPORARY LIEUTENANT-COLONEL C. M. WENYON.

Royal Army Medical Corps.

Director of Research in the Tropics Wellcome Bureau of Scientific Research.

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My examination of the series of 556 cases extended from November 11, 1915, to January 8, 1916. As each case was investigated more than once this involved about 1,500 separate microscopic examinations. These researches of necessity came to an end early in January of this year, owing to my undertaking service

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abroad, but the results I have obtained are of such interest that I think it useful to publish them, if only to draw attention to the percentage of infections with the pathogenic *Entamœba histolytica*, and to enable others who are doing similar work to make a comparison with the results they are obtaining elsewhere.

The examination of this series of cases in London is being continued by Dr. A. C. Stevenson and Mr. Clifford Dobell, at the Wellcome Bureau of Scientific Research, where I carried out my work. Eventually a complete account of the investigations from the side of both bacteriology and protozoology will be published by Drs. Western and Rajchman, and those who have undertaken the protozoological aspect of the question. The present report of my protozoological findings must be regarded, therefore, as of the nature of a preliminary communication.

The method of investigation was as follows: A small sample of the fæces of the patient was sent in an ordinary collecting tube to Professor's Bulloch's laboratory, where Drs. Western and Rajchman first made cultures for bacteriological examination. The tubes of each day were brought to my laboratory at the Wellcome Bureau of Scientific Research in the afternoon, and there I examined at once for protozoal infection. In some cases the samples of fæces had been collected the day before they reached me, so that they were many hours old before examination took place. In all cases the specimens were over three hours old. On this account it is probable that some infections were overlooked, especially those in which only free unencysted forms of *Entamœba coli*, or *E. histolytica* occurred, for these unencysted amœbæ often degenerate and become unrecognizable after being outside the body for some hours. Infections with *Tetramitus mesnili* and *Trichomonas intestinalis* might be missed in a similar manner, for the former usually and the latter sometimes become indistinct in fæces many hours old. *T. intestinalis*, however, frequently survives in fæces as a free-living flagellate, practically unaltered in structure for many days after escape from the body. In the present investigation the infections with protozoa were mostly recognized by the discovery of encysted forms in the fæces, for on account of their enclosing capsules they are resistant structures which survive unchanged for many days after leaving the body. This is especially true of the encysted forms of *E. coli*, *E. histolytica*, *Lamblia intestinalis* and the *Coccidia*. It was only in a small number of these cases that any but the encysted forms were discovered.

Entamœba Histolytica.

The chief importance attaches to the cysts of *E. histolytica*, for their presence in the fæces is an indication of infection of the gut with the pathogenic entamœbæ, with the two accompanying dangers, viz., the danger to the man himself in that he may relapse into a condition of acute dysentery or develop liver abscess, and the danger to other people who may be infected by the cysts he is passing.

Of the 556 cases examined by me, 60, or 10·8 per cent, were passing cysts of the pathogenic entamœbæ, and were, therefore, carriers of *E. histolytica*. It is known that amœbic dysentery was very common on the Gallipoli Peninsula, and the patients were freely treated with emetine, so that the cases found by me in England must represent those who have been inadequately treated or have passed without treatment from the acute condition of amœbic dysentery into that of the amœbic carrier. Others, on the contrary, may have become contact carriers as described by Walker and Sellards in the Philippines, in that they have acquired infection and become carriers, without having at any time showed symptoms of amœbic dysentery. It will be seen below that a still larger percentage of the cases were passing cysts of *E. coli*, hence the importance of distinguishing clearly between the cysts of the two entamœbæ.

I have described elsewhere (*Lancet*, November 27, 1915, Journal of the Royal Army Medical Corps, Vol. xx. No. 6) the method of fæces examination for intestinal protozoa and the characters of the free and encysted forms encountered, so that it is unnecessary to enter into any details here. Suffice it to say that the examinations were carried out as described in my previous paper and that on an average three to five minutes were spent on each specimen of fæces. This may not appear to be a very long examination, but with practice one can work very quickly, and the second and third examinations of the same cases usually showed that the first one had been correct. The large number of protozoal infections discovered, namely, 53·5 per cent of all cases examined, shows that many cannot have been missed.

The importance of the discovery of the *E. histolytica* carriers I have pointed out already and this importance has been emphasized by many observers, amongst whom may be mentioned Darling and James in Panama and Walker and Sellards iu the Philippines.

A very instructive case in this connexion came under my notice some years ago. I was asked by Professor W. J. Simpson to

examine the fæces of one of his patients, a man who had been invalided from India on account of dysentery and who had apparently recovered after treatment and rest in England. He was desirous of returning to India and wished to have a clean bill of health before sailing. I found him to be passing in a normal or almost normal stool the cysts of *E. histolytica* in very large numbers. In spite of advice to the contrary he sailed for India, but became very ill with dysentery at Port Said, where he died after a few days from abscess of the liver. It is probable that suitable treatment with emetine, which, however, was not in general use at that time, would have saved this man's life.

Another case of a similar kind afforded evidence in another way. A lady missionary, not actually suffering from dysentery, was found to be a carrier, as shown by the passage of large numbers of cysts and some "minuta" forms of *E. histolytica*. By means of material from this patient I was able to conduct a series of experiments in cats which threw remarkable light on the latent pathogenic powers of these stages of the entamœba. The experiments were described in the now defunct *Journal of the London School of Tropical Medicine*. The administration of the fæces of this case to cats produced in these animals typical amœbic dysentery and the infection was handed on by subinoculation from cat to cat until finally one cat was found to have developed amœbic abscess of the liver. It is only reasonable to assume that such a carrier case might have just as well infected another human being and produced both dysentery and liver abscess. Experimental infections in man by means of material from carrier cases have been carried out by Walker and Sellards in their most interesting and valuable series of experiments conducted in the Philippines.

In Nature it is difficult to follow the infection from one person to another, for we do not know exactly how and where the encysted forms survive outside the human body. Quite recently, however, a most interesting case of probable infection from a carrier in this country came under my notice in the series of examinations I have made. A labourer in London, who had never been out of England and who had worked on a transport then lying in dock, contracted dysentery. He was admitted to the London Hospital, where the dysenteric symptoms quickly disappeared. He continued ill, however, and was found to have an abscess of the liver. This was opened and drained, and in scrapings from the abscess wall I found motile forms of *E. histolytica*. In the fæces, on the other hand, I found the encysted forms of the same organism. The man unfor-

tunately died, and it was found post mortem that there was a second undiscovered abscess in the liver. In the large intestine there were found only a few small ulcers the size of sixpenny-pieces. The man must undoubtedly have acquired his infection from material from some carrier case who had been at the dock or on the transport.

The introduction into this country of large numbers of carriers will almost certainly be followed by cases of amœbic dysentery amongst the general public. It is unlikely, however, that any great outbreak will occur, for it is improbable that the conditions in England are as favourable for the survival of the encysted forms outside the body as they are in warmer countries where amœbic dysentery is endemic. During the course of my examinations certain cases which have remained for weeks free from *E. histolytica* have suddenly altered in such a way as to suggest that infection with this organism had taken place in hospital from one case to another. Carrier cases would become very dangerous if removed from England to other countries where the conditions are suitable for the spread of *E. histolytica* and might give rise to serious trouble, especially amongst men who were living together in camps and in unfavourable surroundings.

It is, therefore, very important to discover the carrier cases, and this can only be done by the recognition of the encysted forms of the pathogenic entamœba in the fæces. Adequate treatment with emetine will in most cases get rid of the infection. It is frequently stated that the drug has no action on the encysted forms. This is probably true, but is of little consequence if the emetine kills the amœbæ—the "minuta" forms of *E. histolytica* which produce the cysts—for if the amœbæ are killed the cyst production will cease and the cysts already produced will be passed from the intestine in the dejecta. It will be seen from the record of the emetine treated cases given in this paper, that the drug in most instances causes the passage of encysted forms to cease, and this must be because the amœbæ or most of the amœbæ producing them have been killed. It is unfortunate that I have been unable to follow up all the cases with a view to finding out in what percentage of these cases relapses occur after the cessation of treatment. That properly carried out treatment with emetine will abolish infection in carriers is very well illustrated by a case which came under the notice of Dr. G. C. Low and myself. The man had contracted an infection in the Soudan and was found to be passing encysted forms in large numbers. He was kept under observation for some time, during the whole of which he passed *E. histolytica* cysts. He was then

given daily injections of one grain of emetine till he had had about twelve grains. The result was a complete disappearance of his infection, while observations extending over several months after treatment showed that there was no tendency to relapse. Such a favourable result may not be obtained in every patient, but at present the number of properly treated cases which have been controlled by carefully conducted microscopic examination extending over long periods is very small and quite insufficient to allow of the pronouncement of any definite opinion.

As regards the series of cases here recorded, it was advised that a course of emetine should be given to all the men who were found, by the discovery of cysts in the fæces, to be harbouring *E. histolytica*. In many cases it has been impossible to obtain information as to whether this treatment has been carried out, but owing to the kindness of Dr. Western and Dr. Rajchman in securing the data for me, I am able to give the details of treatment of a small number. I think it will be useful to give the results so far as they go on account of the importance of finding out whether emetine is able to clear these carrier cases of the *E. histolytica* as judged by the presence of encysted forms in the fæces.

It will be seen that in all but three cases (111, 235 and 250) the emetine caused the cysts to disappear from the stools, but it is impossible to tell if the cure is a permanent one or not owing to my observations upon the cases coming to an end.

Another interesting point appearing from these treated cases is that the concurrent infection with *E. coli* which existed in some was not abolished by the doses of emetine which were sufficient to kill off the *E. histolytica*. It would appear that the non-pathogenic *E. coli* as it lives in the intestine is more resistant to emetine than the pathogenic *E. histolytica*. In some instances, the infection with *E. coli* was reduced from a large to a small one, so that it is possible that further or more prolonged treatment would get rid of this entamœba also. This, however, is hardly necessary if we regard *E. coli* as harmless, a view which is supported by all available evidence.

As regards the dose of emetine employed, it will be seen that 1 grain daily for twelve days abolished the large infection of Case 129, while the smaller dose of ¼ grain daily for fourteen days in Case 154 had the same result on a similar infection. In the same way in Case 197, the administration of ½ grain for seventeen days followed by 1 grain for four days also got rid of a large infection, while a similar result followed the treatment by

½ grain twice daily for sixteen days in Case 251. In Case 111, however, ½ grain daily for seventeen days, followed by 1 grain daily for four days, was not sufficient, nor did ½ grain twice daily for five or nine days effect a cure in Cases 235 and 250. The three Cases 258, 261 and 321 were all treated on a similar plan of ½ grain three times daily for a few days, then ½ grain twice daily for a few days followed by ½ grain once a day for some days. In all these cases the infection disappeared, but it seems probable that the same result would have been attained with less worry to the patient and a saving of labour for the medical attendant by giving all the daily doses together in a single injection.

The following is a summary of those cases of *E. histolytica* infection about which information as to treatment with emetine was obtained. The subsequent control of the cases inevitably came to an end as explained above, but in certain cases several examinations were made after treatment had been stopped. Counting from the first examination after treatment with emetine had commenced, when *E. histolytica* was found to have disappeared, up to the last examination when it was still absent, certain periods during which relapse had not occurred can be calculated. These periods of freedom from infection are inserted in brackets at the end of the description of the treatment of each case—where no such insertion is made there has only been one negative examination after treatment.

Case 3 had large infections of both *E. histolytica* and *E. coli* and received emetine ½ grain daily for twenty-one days followed by 1 grain daily for four days. The *E. histolytica* infection was reduced but not abolished. The *E. coli* infection was similarly reduced but not abolished.

Case 129 had large infections of both *E. histolytica* and *E. coli* and received emetine 1 grain daily for twelve days. The *E. histolytica* infection disappeared but not the *E. coli* infection (sixteen days).

Case 154 had a large infection of *E. coli* and a small infection of *E. histolytica* and received emetine ¼ grain daily for fourteen days. The *E. histolytica* infection disappeared but not the *E. coli* infection (forty-two days).

Case 197 had a large *E. coli* infection and a fair *E. histolytica* infection and received emetine ½ grain daily for seventeen days, followed by 1 grain daily for some days. The *E. histolytica* infection disappeared but not the *E. coli* infection (six days).

Case 210 had a small *E. histolytica* infection and received emetine 1 grain daily for twelve days. The infection disappeared (thirty-six days).

Case 224 had a fair *E. histolytica* infection and received emetine ½ grain three times daily for eight days. The infection disappeared (nine days).

Case 235 had a large *E. histolytica* infection and received emetine ½ grain twice daily for five days. The *E. histolytica* did not disappear nor was the infection lessened.

Case 239 had a large *E. histolytica* infection and received emetine ½ grain twice daily for four days. The *E. histolytica* disappeared (six days).

Case 250 had a large *E. histolytica* infection and a fair *E. coli* infection and received emetine ½ grain twice daily for nine days. Their was no disappearance of either *E. coli* or the *E. histolytica* infection.

Case 251 had a large *E. histolytica* infection and a fair *E. coli* infection and received emetine ½ grain twice daily for sixteen days. There was a disappearance of the *E. histolytica* infection but not of the *E. coli* infection.

Case 255 had a small *E. histolytica* infection and received emetine ½ grain once daily for ten days. The infection disappeared.

Case 258 had a fair infection of both *E. coli* and *E. histolytica* and received emetine ½ grain three times daily for nine days, followed by ½ grain twice daily for seven days, followed by ½ grain once daily for ten days. The *E. histolytica* infection disappeared but not the *E. coli* infection (seven days).

Case 261 had a small *E. histolytica* infection and a fair *E. coli* infection and received emetine ½ grain three times daily for six days, followed by ½ grain twice daily for four days, followed by ½ grain once daily for nine days. There was a disappearance of the *E. histolytica* but not of the *E. coli* infection (twenty-eight days).

Case 321 had a small *E. histolytica* infection and received ½ grain three times daily for six days, followed by ½ grain twice daily for four days, followed by ½ grain once daily for eight days. The infection disappeared (twenty-three days).

Case 324 had a fair *E. histolytica* infection and a small *E. coli* infection and received emetine ½ grain three times daily for nine days. There was a disappearance of the *E. histolytica* but not of the *E. coli* infection (sixteen days).

As stated above, of the 556 cases examined 60 were infected with *E. histolytica.* There was a pure infection in 22 cases and

a mixed infection in 38, which were distributed as follows: *E. histolytica* with *E. coli* 26, *E. histolytica* with *E. coli* and *Lamblia* 5, *E. histolytica* with *Lamblia* 4, *E. histolytica* with *E. coli, Lamblia* and *Amœba limax* 1, and *E. histolytica* with *E. coli, Lamblia* and *Coccidium* (*Isospora*) 1.

Entamœba coli.

Infection with *Entamœba coli*, the non-pathogenic entamœba, was the commonest type of protozoal infection observed. This was recognized in all cases by the finding of the encysted forms, and only occasionally were the free unencysted entamœbæ seen also. In some cases the infection was a very large one indeed.

Of the 556 cases examined, 217 were found to harbour *E. coli*, and of these 138 were cases of pure infection with this entamœba. There were 79 cases of mixed infection which were distributed as follows: *E. coli* with *E. histolytica* 26, *E. coli* with *Lamblia* 28, *E. coli* with *Coccidium* (*Isospora*) 7, *E. coli* with *Coccidium* (*Eimeria*) 1, *E. coli* with *Trichomonas* 1, *E. coli* with *Amœba limax* 1, *E. coli*, with *Tetramitus* 1, *E. coli* with *E. histolytica, Lamblia* and *A. limax* 1, *E. coli* with *E. histolytica* and *Lamblia* 5, *E. coli* with *Lamblia* and *Trichomonas* 2, *E. coli* with *Lamblia* and *A. limax* 1, *E. coli* with *E. histolytica, Lamblia* and *Coccidium* (*Isospora*) 1, *E. coli* with *A. limax* and *Coccidium* (*Isospora*) 1, *E. coli* with *Lamblia* and *Coccidium* (*Isospora*) 2, *E. coli* with *Trichomonas* and *Tetramitus* 1.

Lamblia intestinalis.

Lamblia intestinalis was found in 91 of the 556 cases examined. Here, again, the infection was recognized by the finding of the encysted forms, and only in a few cases were the free unencysted flagellates seen along with the cysts. As a rule, the infection was not very large, but in some it could only be described as enormous. In these cases the stool generally contained a large amount of mucus in which the *Lamblia*, as free unencysted flagellates, appeared in almost pure culture. One would suspect that here, at any rate, they had been the cause of the excessive mucus production. A pure infection of *Lamblia* was found in 43 cases, while the infection was a mixed one in 46. The latter were as follows: *Lamblia* with *Entamœba coli* 28, *Lamblia* with *E. histolytica* 4, *Lamblia* with *E. coli* and *E. histolytica* 5, *Lamblia* with *E. coli* and *Trichomonas* 2, *Lamblia* with

E. coli and *Coccidium* (*Isospora*) 2, *Lamblia* with *Coccidium* (*Isospora*) 1, *Lamblia* with *E. coli*, *E. histolytica* and *Coccidium* (*Isospora*) 1, *Lamblia* with *E. coli*, *E. histolytica* and *Amœba limax* 1, *Lamblia* with *E. coli* and *A. limax* 1, and *Lamblia* with *A. limax*, *Trichomonas* and *Tetramitus* 1.

Coccidium (Isospora).

The oöcysts of this coccidium, which was described in my paper already referred to, were found in 15 cases. The infection was a pure one in only 2 cases and was mixed with other protozoa in 13, as follows: *Isospora* with *Entamœba coli* 7, *Isospora* with *E. coli* and *Lamblia* 2, *Isospora* with *E. histolytica* 1, *Isospora* with *Lamblia* 1, *Isospora* with *E. coli* and *Amœba limax* 1, *Isospora* with *E. coli*, *E. histolytica* and *Lamblia* 1.

In most of these cases the infection was quite small with only one or two, or at the most ten, oöcysts in each cover-glass preparation. In one case, however, in which a small accompanying *E. coli* infection occurred, the oöcysts were present in very large numbers, one or two or more being found in almost every field of the $\frac{1}{6}$-inch objective. Curiously enough, when I examined the case ten days later no oöcysts could be found, and the same result was the outcome of a third examination after the expiry of another ten days. One would expect that so large an infection by such a parasite as a coccidium, which is parasitic upon and destroys intestinal epithelium, would lead to definite intestinal disease. It may have been that the dysenteric symptoms of this case were due to the coccidium, for no pathogenic bacteria had been isolated from the fæces.

Coccidium (Eimeria).

The Eimeria occurred in only one case and then together with *Entamœba coli*. The oöcysts of this coccidium were described by me in the *Lancet* for December 25, 1915.

All the protozoa described above were recognized in their encysted stages, and this may account for the fact that they were found in a greater number of cases than those to be now mentioned. In the latter definite recognizable cysts do not occur with any freqency in the fæces.

Amœba limax.

Under this name are included small amœbæ which resemble the free-living *Amœba limax*. It is impossible to tell whether the presence of this amœba in any specimen was due to development after the fæces had been passed or whether it occurred in the freshly

passed stool, for, as already explained, the specimens I examined were always some hours old. In one case in which an amœba of this type was recognized a culture was easily obtained on the agar medium recommended by Walker and Sellards. As has been so often explained before, the presence in the fæces of these amœbæ has nothing whatever to do with dysentery, nor has it any connection with either *Entamœba coli* or *E. histolytica*: *A. limax* is ubiquitous and occurs everywhere in Nature either in the free or encysted form. Cultures can very readily be obtained by placing any kind of material on a suitable medium (e.g., Walker and Sellards' modification of Musgrave and Cleggs' medium). In India, Wells has shown that the mere exposure of agar plates to the air will suffice in some instances to give rise to cultures of these amœbæ. The cultures in such cases must arise from the small resistant cysts which blow about in the air. Hence it is not a matter of surprise that the cysts of this amœba are constantly being ingested in food and water, and that they pass through the intestine to escape in the fæces. The fæces in these cases will quickly give rise to cultures of *A. limax* or similar forms if they are kept for some time at ordinary laboratory temperatures. The same explanation accounts for the appearance in kept fæces of various flagellates such as *Bodo*, *Prowazekia* and *Cercomonas*. It may, and probably does, happen that occasionally the amœbæ escape from the cysts in the lower part of the large intestine, and give rise to a temporary infection of the gut. This seems to be the explanation of the presence of amœbæ of the *A. limax* type which one encounters sometimes in perfectly fresh material.

In the series examined by me an amœba of this type was found in six cases, once alone, and five times with other protozoa as follows: *A. limax* with *Entamœba coli* 1, *A. limax* with *E. coli* and *Coccidium* (*Isospora*) 1, *A. limax* with *E. coli* and *Lambli* 1, *A. limax* with *E. coli*, *E. histolytica* and *Lamblia* 1, and *A. limax* with *Lamblia*, *Trichomonas* and *Tetramitus* 1.

Trichomonas intestinalis.

This flagellate was found in only nine cases, four times alone and five times with other protozoa as follows: *Trichomonas* with *Entamœba coli* and *Lamblia* 2, *Trichomonas* with *E. coli* and *Tetramitus* 1, *Trichomonas* with *E. coli* 1, and *Trichomonas* with *Amœba limax*, *Lamblia* and *Tetramitus* 1.

In one case of large *Trichomonas* infection the flagellates survived in the fæces kept at ordinary laboratory temperature for over

ten days. They remained active and apparently unaltered during this time. Attempts were made to cultivate them on various media, notably the lettuce medium with which Escomel claimed success, acid broth, and various vegetable modifications of these. Furthermore, ordinary tap-water, saline solution, and water from the Serpentine lake in Hyde Park were used, but without success. The *Trichomonas* survived longer in the fæces as they remained in the sample tube on the laboratory bench than in any of the various media employed. A second attempt at culture made with material from another case likewise ended in failure.

Tetramitus mesnili.

This flagellate was found in only three cases, once with *Entamœba coli,* once with *E. coli* and *Trichomonas* and once with *Amœba limax, Lamblia* and *Trichomonas.* It was found that *Tetramitus* degenerated in the fæces much more quickly than *Trichomonas.* An attempt at culture as described above for *Trichomonas* was made in one case, but no success resulted.

The following is a summary of the 295 protozoal infections found amongst the 556 cases examined:—

	Pure infection	Mixed infection	Total
E. coli	138	79	217
E. histolytica	22	38	60
A. limax	1	5	6
Lamblia intestinalis	43	46	89
Trichomonas intestinalis	4	5	9
Tetramitus mesnili	—	4	4
Coccidium (Isospora)	2	13	15
Coccidium (Eimeria)	—	1	1

Vegetable Organisms, excluding Bacteria.

Vegetable organisms of many kinds were present in the stools. Often they occurred in great abundance and were due to multiplication of yeasts and fungi after the fæces had been passed. Spores of fungi germinated and gave rise to networks of filaments while the yeasts reproduced rapidly by budding. Blastocystis was exceedingly common and as is usual varied very much in size. Sometimes large forms as big or even bigger than the cysts of *Entamœba histolytica* occurred, but more usually they were smaller than this.

Another organism which is important on account of its resemblance to the cysts of *E. histolytica* was met with in twenty-nine cases. It appears as a characteristic body, generally spherical but sometimes irregular in outline. There is an enclosing transparent

capsule of double contour surrounding a mass of cytoplasm in which lie a single small nucleus and a larger mass which, having a strong affinity for iodine, stains a deep mahogany colour. The iodophilic body in these cysts varies much in size. It may be irregular in shape, and sometimes there are two or three separate bodies present. When there is a large infection with these cysts it will be noticed that a certain number of cysts occur which have no iodophilic body but which agree in other respects. As the iodophilic body in the typical cysts may be quite small it is not surprising that sometimes these cysts have no iodophilic body whatever. In such cases the resemblance to the cysts of *E. histolytica* would be still greater though their general appearance and the small size of the nucleus should make separation generally easy. These cysts were described by me as I-cysts in my article in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS. Their vegetable nature is proved by the fact that they germinate when kept in fæces. Nothing is known of the effect they have on the intestine. In some of the cases examined they persisted for several weeks in very large numbers and it is possible that here they had some pathogenic action. The I-cysts were found without any accompanying infection in six cases and with various protozoa in twenty-three cases.

The following table gives a list of those cases in which protozoa were found and shows the type of infection in each.

	Record number	*Entamœba coli*	*Entamœba histolytica*	*Amœba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*		Record number	*Entamœba coli*	*Entamœba histolytica*	*Amœba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*
1	11	..	..	..	+	..	..	..	..	15	114	+	..	..	+	..	..	..	..
2	55	..	..	..	+	..	..	..	..	16	117	+	..	..	+	+	..	..	..
3	62	+	..	..	..	..	..	..	..	17	124	+	..	..	..	..	..	..	..
4	67	+	..	..	..	..	..	..	..	18	125	..	..	..	+	..	..	..	..
5	80	+	..	..	..	..	..	..	..	19	126	+	..	..	..	..	..	..	..
6	81	+	..	..	..	..	..	..	..	20	127	+	..	..	+	..	..	..	..
7	85	+	+	..	..	..	..	..	..	21	128	..	..	..	+	..	..	..	..
8	90	+	..	..	..	..	..	..	..	22	129	+	+	..	..	..	..	..	..
9	103	..	+	..	..	..	..	..	..	23	134	+	..	+	+	..	..	..	..
10	104	+	..	..	..	..	..	..	..	24	135	+	..	..	+	..	..	..	..
11	105	+	..	..	..	..	..	..	..	25	136	+	+	..	+	..	..	..	..
12	109	+	..	..	+	..	..	..	..	26	137	+	..	..	..	..	..	..	..
13	110	+	+	..	+	..	..	+	..	27	141	+	..	..	+	..	..	..	..
14	113	+	..	..	..	..	..	..	..	28	142	+	..	..	..	..	..	..	..

	Record number	*Entamoeba coli*	*Entamoeba histolytica*	*Amoeba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*		Record number	*Entamoeba coli*	*Entamoeba histolytica*	*Amoeba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*
29	144	+	..	..	..	..	..	..	..	81	252	+	..	..	..	..	..	..	..
30	145	..	..	..	+	..	..	..	..	82	253	+	+	..	+	..	..	..	..
31	146	..	..	..	+	..	..	..	..	83	254	+	..	..	..	..	..	..	..
32	152	..	..	..	+	..	..	..	..	84	255	..	+	..	..	..	..	..	..
33	154	+	+	..	..	..	..	..	..	85	258	+	+	..	..	..	..	..	..
34	155	+	..	..	+	..	..	..	..	86	259	+	..	..	..	..	..	+	..
35	159	..	..	..	+	..	..	..	..	87	261	+	+	..	+	..	..	..	..
36	169	..	..	..	+	..	..	..	..	88	262	+	..	..	..	..	..	..	..
37	171	+	..	..	..	..	..	..	..	89	265	..	..	..	..	+	..	..	..
38	172	..	..	..	+	..	..	..	..	90	267	..	+	..	..	..	..	..	..
39	174	+	..	..	+	..	..	..	..	91	269	..	..	..	+	..	..	..	..
40	177	+	..	..	..	..	..	..	..	92	271	+	..	..	+	..	..	..	..
41	180	+	..	..	..	..	..	..	..	93	273	+	..	..	..	..	..	..	..
42	182	+	..	..	..	..	..	..	..	94	274	+	..	..	..	..	..	..	..
43	184	+	..	+	..	..	..	+	..	95	276	+	..	..	+	..	..	..	..
44	188	+	+	..	..	..	..	..	..	96	278	+	..	..	..	..	..	..	..
45	192	+	..	..	..	..	..	..	..	97	279	..	..	..	+	..	..	..	..
46	193	+	..	..	..	..	..	..	..	98	281	+	..	..	+	..	..	..	..
47	197	+	+	..	..	..	..	..	..	99	282	+	..	..	+	..	..	..	..
48	201	..	..	+	..	..	..	..	..	100	283	..	..	..	+	..	..	..	..
49	202	+	..	..	..	..	..	..	..	101	285	+	..	..	..	..	..	..	..
50	203	+	..	..	+	..	..	..	..	102	286	+	..	..	..	..	..	..	..
51	209	+	..	..	..	..	..	..	..	103	287	..	..	..	+	..	..	..	..
52	210	..	+	..	+	..	..	..	..	104	288	+	..	..	+	..	..	..	..
53	211	+	..	..	..	..	+	..	..	105	291	+	..	..	..	..	..	..	..
54	214	+	..	..	+	..	..	+	..	106	293	+	..	..	..	..	..	..	..
55	216	+	..	..	..	..	..	+	..	107	295	+	..	..	..	..	..	..	..
56	218	+	..	..	..	..	..	..	..	108	296	+	..	..	..	..	..	..	..
57	221	+	..	..	..	..	..	..	..	109	297	+	..	..	+	..	..	..	..
58	222	+	..	..	..	..	..	+	..	110	299	+	..	..	..	..	..	..	..
59	223	+	..	..	+	..	..	..	..	111	301	+	..	..	..	..	..	..	..
60	224	..	+	..	..	..	..	..	..	112	302	..	..	..	+	..	..	..	..
61	225	..	..	..	+	..	..	..	..	113	303	+	+	..	..	..	..	..	..
62	228	+	..	..	..	..	..	..	..	114	304	+	..	..	..	..	..	..	..
63	229	+	..	..	..	..	..	..	..	115	305	+	..	..	+	..	..	+	..
64	230	..	..	+	+	+	+	..	..	116	306	..	..	..	+	..	..	..	..
65	232	..	..	..	+	..	..	..	..	117	309	+	..	..	..	..	..	..	..
66	233	+	..	..	..	..	..	..	..	118	310	..	..	..	+	..	..	..	..
67	234	+	..	..	+	+	..	..	..	119	311	..	..	..	..	+	..	..	..
68	235	..	+	..	..	..	..	..	..	120	316	..	..	..	+	..	..	+	..
69	238	+	..	..	+	..	..	..	..	121	317	+	..	..	..	..	..	..	..
70	239	..	+	..	..	..	..	..	..	122	319	..	..	..	..	..	..	+	..
71	240	+	..	..	..	..	..	..	..	123	321	..	+	..	..	..	..	..	..
72	242	+	..	..	..	..	..	..	+	124	322	+	..	..	+	..	..	..	..
73	243	+	..	..	..	..	..	..	..	125	323	+	..	..	..	..	..	..	..
74	244	..	+	..	..	..	..	..	..	126	324	+	+	..	..	..	..	..	..
75	245	+	..	..	..	..	..	..	..	127	325	+	..	..	..	..	..	..	..
76	246	..	..	..	+	..	..	..	..	128	326	+	..	..	..	..	..	..	..
77	247	+	..	..	..	..	..	..	..	129	327	..	+	..	+	..	..	..	..
78	248	..	+	..	..	..	..	..	..	130	332	..	..	..	+	..	..	..	..
79	250	+	+	..	..	..	..	..	..	131	334	+	+	..	+	..	..	..	..
80	251	+	+	..	..	..	..	..	..	132	335	+	..	..	..	..	..	..	..

	Record number	*Entamoeba coli*	*Entamoeba histolytica*	*Amoeba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*
133	336	+	..	..	..	..	..	..	..
134	338	+	..	..	..	..	..	..	..
135	341	..	+	..	..	..	..	..	..
136	342	..	..	..	+	..	..	..	..
137	344	+	..	..	..	..	..	..	..
138	345	..	..	..	+	..	..	..	..
139	346	+	..	..	..	..	..	..	..
140	347	+	..	..	..	..	..	..	..
141	351	+	..	..	..	..	..	..	..
142	354	+	+	..	..	..	..	..	..
143	358	..	+	..	+	..	..	..	..
144	359	..	..	..	+	..	..	..	..
145	360	+	..	..	..	..	..	..	..
146	362	+	..	..	..	..	..	..	..
147	363	+	..	..	+	..	..	..	..
148	364	+	..	..	..	..	..	..	..
149	366	+	+	..	..	..	..	..	..
150	367	+	..	..	+	..	..	..	..
151	369	+	..	..	+	..	..	..	..
152	370	+	..	..	..	..	..	..	..
153	372	+	..	..	..	..	..	..	..
154	374	+	+	..	..	..	..	..	..
155	376	+	..	..	..	..	..	..	..
156	378	+	..	..	..	..	..	..	..
157	380	+	..	..	+	..	..	..	..
158	384	+	+	..	..	..	..	..	..
159	386	+	..	..	..	..	..	..	..
160	388	+	..	..	+	..	..	..	..
161	391	..	..	..	+	..	..	..	..
162	393	..	..	..	+	..	..	..	..
163	395	+	+	+	+	..	..	..	..
164	396	+	..	..	..	+	+	..	..
165	397	..	..	..	+	..	..	..	..
166	402	+	..	..	..	..	..	..	..
167	404	..	..	..	..	..	..	+	..
168	405	+	+	..	..	..	..	..	..
169	406	..	..	..	+	..	..	..	..
170	407	+	..	..	..	..	..	+	..
171	408	..	+	..	+	..	..	..	..
172	409	+	..	..	..	..	..	..	..
173	410	+	+	..	..	..	..	..	..
174	411	+	..	..	..	..	..	..	..
175	415	+	..	..	..	..	..	..	..
176	417	+	..	..	..	..	..	..	..
177	418	+	..	..	..	..	..	..	..
178	420	+	..	..	..	..	..	..	..
179	421	+	+	..	..	..	..	..	..
180	424	+	..	..	..	..	..	..	..
181	427	+	..	..	..	..	..	..	..
182	428	..	+	..	..	..	..	..	..
183	429	+	..	..	..	..	..	..	..
184	432	+	..	..	..	..	..	..	..
185	433	+	..	..	+	..	..	..	..
186	435	+	..	..	..	..	..	..	..
187	438	+	..	+	..	..	..	..	..
188	439	+	..	..	..	..	..	..	..
189	440	..	..	..	+	..	..	..	..
190	441	..	+	..	..	..	..	..	..
191	444	+	..	..	..	..	..	..	..
192	445	+	..	..	..	..	..	..	..
193	446	+	..	..	..	..	..	..	..
194	450	..	+	..	..	..	..	..	..
195	453	+	..	..	..	..	..	..	..
196	454	..	..	..	..	+	..	..	..
197	455	+	..	..	..	..	..	..	..
198	456	+	..	..	..	..	..	..	..
199	457	+	..	..	..	..	..	+	..
200	459	+	..	..	..	..	..	..	..
201	461	+	..	..	..	..	..	+	..
202	462	+	..	..	+	..	..	..	..
203	463	+	..	..	+	..	..	..	..
204	464	+	..	..	..	..	..	+	..
205	465	+	+	..	..	..	..	..	..
206	466	..	..	..	+	..	..	..	..
207	472	+	..	..	..	..	..	..	..
208	473	+	..	..	..	..	..	..	..
209	475	+	..	..	..	..	..	..	..
210	477	+	..	..	..	..	..	..	..
211	478	..	+	..	..	..	..	..	..
212	479	+	..	..	..	..	..	..	..
213	480	..	..	..	+	..	..	..	..
214	483	+	..	..	..	..	..	..	..
215	484	+	..	..	..	..	..	..	..
216	485	+	..	..	..	..	..	..	..
217	486	+	..	..	..	..	..	..	..
218	488	+	..	..	..	..	..	..	..
219	489	+	..	..	..	..	..	..	..
220	490	..	..	..	+	..	..	..	..
221	496	+	..	..	..	..	..	..	..
222	498	+	..	..	..	..	..	..	..
223	499	+	..	..	..	..	..	..	..
224	500	+	..	..	..	..	..	..	..
225	501	+	..	..	..	..	..	..	..
226	502	+	..	..	+	..	..	..	..
227	508	+	..	..	..	..	..	..	..
228	509	+	..	..	..	..	..	..	..
229	510	+	..	..	..	..	..	..	..
230	515	+	..	..	+	..	..	..	..
231	521	+	..	..	..	..	..	..	..
232	523	..	+	..	..	..	..	..	..
233	527	+	+	..	..	..	..	..	..
234	532	+	+	..	..	..	..	..	..
235	534	+	..	..	..	..	..	..	..
236	535	..	..	..	+	..	..	..	..

	Record number	*Entamœba coli*	*Entamœba histolytica*	*Amœba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*
237	539	+	..	..	..	..	..	..	..
238	543	+	+	..	..	..	..	..	..
239	545	+	..	..	..	..	..	..	..
240	546	+	..	..	..	..	..	+	..
241	547	+	+	..	+	..	..	..	..
242	551	+	..	..	..	..	..	..	..
243	554	+	..	..	..	..	..	..	..
244	555	+	+	..	..	..	..	..	..
245	556	+	..	..	..	..	..	..	..
246	557	+	+	..	..	..	..	..	..
247	559	+	+	..	..	..	..	..	..
248	561	..	..	..	+	..	..	..	..
249	564	+	..	..	..	..	..	..	..
250	568	+	+	..	..	..	..	..	..
251	570	..	+	..	..	..	..	..	..
252	571	..	..	..	+	..	..	..	..
253	572	+	..	..	..	..	..	..	..
254	573	+	..	..	..	..	..	..	..
255	579	+	..	..	..	..	..	..	..
256	580	+	..	..	..	..	..	..	..
257	581	+	..	..	..	..	..	..	..
258	582	+	..	..	..	..	..	..	..
259	583	..	+	..	..	..	..	..	..
260	584	+	..	..	..	..	..	..	..
261	587	+	..	..	..	..	..	..	..
262	589	+	..	..	..	..	..	..	..
263	591	..	+	..	..	..	..	..	..
264	594	..	..	..	+	..	..	..	..
265	595	..	..	..	+	..	..	..	..
266	597	+	..	..	..	..	..	..	..
267	598	..	+	..	..	..	..	..	..

	Record number	*Entamœba coli*	*Entamœba histolytica*	*Amœba limax*	*Lamblia intestinalis*	*Trichomonas intestinalis*	*Tetramitus mesnili*	*Coccidium (Isospora)*	*Coccidium (Eimeria)*
268	600	+	..	..	..	..	..	..	..
269	603	+	..	..	..	..	..	..	..
270	606	+	+	..	..	..	..	..	..
271	611	+	..	..	..	..	..	..	..
272	613	..	..	..	+	..	..	..	..
273	614	+	..	..	..	..	..	..	..
274	623	..	..	..	+	..	..	..	..
275	625	..	..	..	+	..	..	..	..
276	632	+	..	..	..	..	..	..	..
277	635	+	..	..	..	..	..	..	..
278	637	..	..	..	+	..	..	..	..
279	639	+	..	..	..	..	..	..	..
280	640	..	..	..	+	..	..	..	..
281	641	..	+	..	..	..	..	..	..
282	642	+	..	..	..	..	..	..	..
283	644	+	..	..	..	..	..	..	..
284	646	+	..	..	+	..	..	..	..
285	647	+	+	..	..	..	..	..	..
286	648	+	..	..	..	..	..	..	..
287	652	..	+	..	..	..	..	..	..
288	654	..	..	..	+	..	..	..	..
289	655	..	..	..	+	..	..	..	..
290	660	+	..	..	..	..	..	..	..
291	663	..	+	..	..	..	..	..	..
292	664	..	..	..	..	+	..	..	..
293	666	+	..	..	..	..	..	..	..
294	669	+	..	..	..	..	..	..	..
295	671	+	..	..	..	+	..	..	..
296	672	+	..	..	..	..	..	..	..
297	675	+	..	..	..	..	..	..	..

A SHORT ACCOUNT OF THE SEARCH FOR TYPHOID CARRIERS AMONG EIGHT HUNDRED CONVALESCENTS.

By Captain A. STOKES and Lieutenant C. CLARKE.
Royal Army Medical Corps.

In the late months of 1914 and the early months of 1915 a serious epidemic of typhoid fever had occurred amongst the civilian inhabitants of an area about to be taken over by British troops. In order to diminish the risk of the epidemic spreading to the troops coming into the area the sanitary officers of the Royal Army Medical Corps advised that the civilians at that time ill and those convalescents who could be found should be removed to an isolation hospital some distance from the area, and kept there till they should be proved free from infection. The following is an account of the attempt to eliminate the "carriers" before the discharge of the patients.

The patients were searched for in their homes by search parties under the direction of the Royal Army Medical Corps authorities, removed to local hospitals, and when they were in a condition to travel were removed to the isolation hospital. Owing to this method a large majority of the patients arrived at the hospital convalescent and the diagnosis had to rest on the history provided and agglutination reactions, very few of the first parties of patients arriving in the acute stage of the disease. For this reason an accurate idea of the actual numbers who had suffered from enteric was difficult to obtain and, further, it was not easy to estimate the relative proportion of true typhoid to paratyphoid B infections. This difficulty was increased as many of the patients had been inoculated with stock Army vaccine, many others had been treated with mixed typhoid group vaccines while they were ill and very few of them knew if they had or had not been inoculated. Of nine hundred and twenty-seven admissions it was estimated that one hundred and seventeen had certainly not had typhoid but had suffered from tuberculosis, diphtheria, or bad food.

Diagnosis.

A bacteriological diagnosis was definitely obtained in only 165 cases, the infecting organisms being isolated from the blood, excreta, rose spots (10 cases), and from the gall-bladder of some

of those that came to autopsy. *Bacillus typhosus* was found in 145 cases, *B. paratyphosus* B in 19 cases and *B. paratyphosus* A in only 1 case.

The proportion of seven cases of *B. eberth* infection to one paratyphosus B is possibly correct for the earlier part of the epidemic, but the cases admitted during the later stages showed a proportion of four *B. eberth* to five paratyphosus B. In the remainder of the cases the diagnosis depended on agglutinations. These were done microscopically and after twenty minutes' incubation were examined with a dark ground illumination, this method of examination giving very clear-cut readings. Any serum that gave a negative or doubtful reaction to *B. eberth* was tested against *B. paratyphosus* B. A dilution of 1 in 100 of the serum giving a well-marked reaction was considered sufficiently high for *B. eberth* and 1 in 250 to 1 in 500 for *B. paratyphosus* B was read as positive. Later on, as the facilities developed, macroscopic agglutinations as recommended by Dreyer were used with success, and positive reactions were obtained in very much higher dilutions, 1 in 1,000 to 1 in 2,500 in patients convalescent from *B. eberth* infections, and 1 in 5,000 to 1 in 20,000 in *B. paratyphosus* B. Any uninoculated patient who gave a negative agglutination reaction was excluded, and those inoculated before admission as convalescents and in whom from their history it was not possible to exclude enteric fever, were included as probable cases and were examined before discharge. This would lead to a certain number of inoculated patients who had not suffered from enteric being included and, therefore, the percentage of carriers found would appear low, but in the presence of a widespread epidemic it was considered wise to err on the safe side.

Examination before Discharge.

The patients were examined at varying periods of their convalescence, and until the large accumulation of convalescents awaiting discharge had been dealt with the majority were not examined till the tenth to the sixteenth week after the commencement of the illness, but as the accumulation was worked off they were examined at any time after their defervescence that the medical officer in charge regarded them as fit for discharge. The excreta of patients, both fæces and urine, were invariably examined before their names were put on the discharge list. During the first three weeks the examinations were conducted under considerable

difficulties owing to the lack of a laboratory at the hospital which entailed the transport of the specimens a considerable distance and prevented their being examined in a perfectly fresh state. When the necessary equipment arrived and the laboratory was opened at the hospital, the patients were given, the night before examination, a purgative, and the specimen was brought to the laboratory as soon as it was possible. The specimens were generally all available by 9 a.m. and any specimen arriving after 11 a.m. was not examined as it was thought that the patient must have been constipated and the specimen would not give a fair chance of finding enteric group organisms, as it is a well-established fact that prolonged delay in the colon gives the *Bacillus coli* group the opportunity to outgrow *B. eberth.* The technique of the examinations varied as our experience grew and as our results suggested modifications. At first, owing to the very large accumulation of patients awaiting discharge, it was only possible to do a single examination in each case. This was done by direct plating of the stools on several MacConkey plates; one hundred and thirty-seven patients were examined in this way and liberated after one examination. We then adopted Browning's brilliant-green technique and examined the excreta on two occasions, as often as possible on two consecutive days, as we thought that with two purgings we would be more likely to obtain a specimen which had not been unduly delayed in the colon. A thick emulsion of the stools was made in water and after the solids had settled to the bottom, in about twenty minutes, the brilliant-green tubes were inoculated with the supernatant fluid, about five or six large loops being used for each brilliant-green tube. At first we used four dilutions of brilliant-green, 0·25, 0·4, 0·5, 0·6 cubic centimetre of 1 in 10,000 dilution being added to ten cubic centimetre tubes of two per cent peptone water. The tubes were incubated for twenty-four hours and plated on Endo's fuchsin-agar, and examined after twenty hours' incubation. The results obtained in this way were satisfactory but the technique was very laborious, further, we found that when a carrier was found the best dilution was 0·5 cubic centimetre of brilliant-green solution, in some cases the culture being pure. About one hundred examinations were done in this way, and then we determined to try direct plating. After doing a further one hundred examinations, we came to the conclusion that we would get the best results by combining the two methods with a slight modification of the technique originally recommended by Browning.

We made the usual thick emulsion, which was allowed to

settle, then six large loops of the emulsion were transferred to one tube of peptone water with 0·5 cubic centimetre of 1 in 10,000 brilliant-green added to it; this was incubated for eight to ten hours and then plated on Endo's medium, the plate being examined at the end of twenty hours. At the same time one plate was spread from the emulsion, a very small loop of the emulsion being taken and spread in successive quadrants of the plate. The plates were examined with a lens and all likely colonies pricked off into lactose, mannite, saccharose, and broth. The broth tube was examined for motility, and if the sugar reactions were those of the typhoid group, for agglutination with the specific sera. We used the sera supplied by the Lister Institute and at one-half their extreme titre; Eberth serum of a titre of 1 in 2,000 was diluted so as to give a dilution of 1 in 1,000 in the agglutination preparation; at this dilution we never experienced any difficulty from cross-agglutination or the presence of group agglutination. The sugar reactions being positive and the agglutination good, we placed the organism in the typhoid group and regarded the patient from whom it was isolated as a temporary carrier, the further sugar and milk reactions being started as a final confirmation. We found litmus-whey-agar a most useful medium, and with it we found it possible to get the milk reactions in thirty-six hours instead of waiting fourteen days. There were no abnormal strains found among the Eberth strains isolated, they all were motile and easily agglutinable. The paratyphoid A did not form gas in mannite or glucose in Durham tubes, but when planted in solid glucose agar it made gas abundantly. One paratyphoid B strain was apparently self-agglutinating, and in broth culture appeared as large clumps with some motile forms, the clumps being themselves motile.

Carriers Found.

An arbitrary period of three months after the first onset of the fever is taken as the time when a patient should have ceased to excrete typhoid bacilli. Patients excreting up to that time, and not after, are regarded as temporary carriers; if they continue to excrete after that time they are regarded as chronic carriers. We quote, for the sake of comparison, Klinger's figures for the examination of six hundred and four convalescents :—

Temporary intestinal	..	..	70, or 11 per cent.
Temporary urinary ..	..	..	10, or 1·7 ,,
Chronic intestinal ..	..	..	6, or 1 ,,

Our figures were as follows for eight hundred and ten cases examined, of which some probably had not enteric, as was explained above, and many were not examined in the "temporary carrier" period.

Temporary intestinal	32, or 4 per cent.
Temporary urinary	33, or 4 ,,
Chronic intestinal	11, or 1·6 ,,
Chronic urinary	2, or 0·24 ,,

These carriers were divided as to sex as follows :—

TEMPORARY CARRIERS.

		B. eberth	*B. paratyphosus* B	*B. paratyphosus* A
Male intestinal..	13	8	5	—
Female intestinal	19	12	6	1
Male urinary ..	24	24	—	—
Female urinary	9	9	—	—

Of these temporary carriers there were only thirteen who persistently excreted after the primary examinations, and these eventually became chronic carriers. The sex distribution was as follows :—

CHRONIC CARRIERS.

		B. eberth	*B. paratyphosus* B
Male intestinal	3	3	—
Female intestinal	8	3	5
Male urinary	2	2	—
Female urinary	—	—	—

The well-known fact that females more often become chronic carriers than males is well shown in these figures, the incidence of female chronic carriers being nearly three times that of males. All carriers discovered at the first or second examination were kept under supervision in the hospital and examined at weekly intervals, two examinations being made on successive days, until they should have ceased to excrete typhoid bacilli. Six consecutive negative examinations were required as the standard before the patient was deemed fit for discharge. One carrier who eventually became a chronic carrier had a period of intermission during her examinations, being negative on five successive occasions, but on the last before discharge *B. eberth* was again found, and after this intermission the patient continued to excrete quite regularly for three months. The other chronic carriers were easily detected at each examination. No patient was found excreting *B. paratyphosus* B in the urine either in the acute or convalescent stage of the disease. Among the female intestinal carriers of which there were nineteen, six were found on the second examination, the first having been negative. The second examination was made

on the second successive day of purging, which indicates the importance of getting a specimen which has undergone as little intestinal delay as possible.

Comparison of the Two Methods of Examination.

It would require a very large number of examinations to come to a conclusion as to the relative merits of the two methods we used. The following is a short summary of twenty-six carriers found while we were using the two methods in conjunction :—

		Direct plate	Brilliant-green plate
B. eberth	15 ..	15 ..	14
B. paratyphosus B ..	11 ..	3 ..	8

This leaves out of the picture the relative ease of the two methods so far as finding the colonies, and the balance from this point of view is strongly in favour of the brilliant-green method, in which we found it common to get a practically pure plate of the typhoid group organism. On the other hand, *B. eberth* seems more susceptible to the action of brilliant-green, or it may be that its relatively slower rate of growth does not allow it to take the advantage of the lowered competition as quickly as the faster growing *B. paratyphosus* B. At any rate, we did not so often get a pure or nearly pure plate with *B. eberth*, and in some cases we obtained negative results when the direct plate had been positive. Some typical cases are shown here in their successive examinations :—

M. D., *B. eberth*.

	Direct plate	Brilliant-green plate
April 14, 1915	Positive	Negative.
,, 15, ,, ...	,, ...	,,
May 7, ,, ...	,, ...	Positive.
,, 8, ,, ...	,, ...	,,
,, 31, ,, ...	,, ...	Negative.
June 1, ,, ...	,, ...	,,
,, 26, ,, ...	,, ...	In 4 dilutions of brilliant-green = negative.

P. W., *B. paratyphosus* B.

May 3, 1915	Negative	Negative.
,, 4, ,, ...	Positive	Positive.
,, 31, ,, ...	Negative	Pure culture.
June 1, ,, ...	,, ...	,,
,, 26, 28, 29, 1915 ..	,, ...	,,
July 14, 1915	3 colonies	,,

G. D., *B. eberth.*

	Direct plate	Brilliant-green plate
May 27, 1915	10 colonies	Negative.
June 4, ,,	8 ,,	Pure growth.
,, 5, ,,	Numerous	,,
,, 8, ,,	,,	,,
,, 9, ,,	40 colonies	60 colonies.
,, 10, ,,	Numerous	6 colonies, twenty-four hours' incubation; negative, thirty-six hours' incubation.
,, 13, ,,	Pure growth	Negative.
,, 15, ,,	Negative	,,
,, 19, ,,	Positive	,,

M. D., *B. eberth.*

	Direct plate	Brilliant-green plate
,, 4, ,,	(?)	Pure growth.
,, 7, ,,	6 colonies	,,
,, 9, ,,	Almost pure	Numerous.
,, 10, ,,	6 colonies	6 colonies after twenty-four hours' incubation in brilliant-green; negative after thirty-six hours.
,, 14, ,,	Negative	Negative.
,, 15, ,,	Few colonies	,,
,, 16, 17, 18, 19, 1915	,,	,,

This series of four cases in which the examinations are quoted shows well the advisability, when possible, of combining the two methods of examination. The plates were in each case examined by the same observer, and the technique was identical in each case, yet the variability of the results is marked. It further confirms the contention that it is better to incubate the brilliant-green cultures only nine hours, as after that, at least in the case of *B. eberth,* the organism is sometimes overgrown. We never found this in the case of paratyphoid B, in which the brilliant-green plate was generally very much the better and often the plate showed a pure culture.

Treatment.

As to the treatment of the intestinal carriers, which has always been a very difficult matter, we only tried two experiments. Arsenic in the form of Fowler's solution having been found to be useful in eliminating *B. eberth* from the stools, we thought that possibly the intravenous administration of salvarsan would give a better chance of getting the arsenic to the site of growth of the organisms—i.e., the gall-bladder and bile-ducts and capillaries—accordingly two intestinal carriers were given three grammes of

salvarsan intravenously. It did not alter their condition in the least, as they both continued to excrete for some time after the administration.

Of the temporary urinary carriers, only two of the thirty-four found became chronic carriers. The thirty-two temporary carriers were treated with urotropine for a period of about ten days, and then after an interval of one week were re-examined, and all consistently proved negative on four consecutive examinations. The two who excreted bacilli after the twelfth week from the commencement of their illness, and in one of the cases up to the twentieth week, suffered from relapses in the late period of their convalescence. They both continued to excrete up to the eighth week in one case and the tenth week in the other case after the inception of the relapse, and were apparently benefited by the treatment, so that we give it in detail.

A. H., aged 13. Illness commenced January 26, 1915, admitted on thirty-seventh day. Widal positive to *B. eberth.* Relapse twelfth week. Defervescence complete on the twelfth day. Urine contained *B. eberth* on the following dates: April 14, 18, 29, 1915, May 25, 28, 1915, June 13, 1915. He had been through the routine course of urotropine during the period of these examinations.

June 15, 1915, urine positive, no albumin. June 16, 1915. 500 mille stock Army vaccine; local, well-marked reaction; general slight temperature, 98·8° F.; focal, cloud of albumin; culture positive. June 17, 1915, by mouth, six-hourly: Urotropine, 10 gr., ac. sodii phos., 20 gr., ac. boric., 3 gr.

Subsequent examination of the urine was as follows:—

June 17, 18, 19, 21, 22, 23, 1915, decreasing albumin and colonies. June 24, 1915, negative as regards albumin and culture sterile. June 25, 1915, 1,000 mille Army vaccine. Mixture discontinued. June 27, 1915, five colonies, no albumin. Examinations on the following dates were always negative: July 1, 2, 3, 6, 13, 15, 1915.

Case 2.—H. M., aged 67. Illness commenced February 25, 1915, relapse seventh week. *B. eberth* found in the urine on the following dates. May 24, 1915, June 3, 8, 14, 1915. During this period he had the routine administrations of urotropine. June 16, 1915, 1,000 mille Army vaccine; local, slight reaction; general, marked, temperature, 101·1° F.; focal, heavy cloud of albumin, erythrocytes and leucocytes in deposit; frequency for twenty-four hours. June 17, 1915, culture positive. Mixture ordered. June 18, 19, 1915, cultures negative and albumin decreasing. June 25, 1915 ,000 mille Army vaccine. No reaction. Mixture discontinued.

Subsequent examinations of the following dates were consistently negative: June 28, 1915, July 1, 6, 12, 1915. The albumin never reappeared after June 20, 1915, four days after the first dose of vaccine.

These two cases were apparently benefited by the treatment, as after they had recovered from the focal reaction, which was marked in both cases, they ceased to excrete *B. eberth*. The presence of the rather marked focal reaction is also suggestive, and leads us to hope that there is, perhaps, a better chance of getting rid of the renal focus in urinary carriers with a large dose of vaccine than has been attained by the smaller doses.

Age-incidence of Carriers.

The age-incidence of carriers is of interest and the results bear out the known fact that temporary carriers occur more frequently in the early period of life, and that chronic carriers are most often found among the middle-aged. Of three hundred and fifty women over 15 years examined, eight were found to be chronic carriers, their average age being 45 years; this, however, did not appear to hold good among the males, as two of the three chronic intestinal carriers were under 20 years. We give here the list of the chronic carriers and the dates of examination, inception of fever, and age of the patients.

Females.

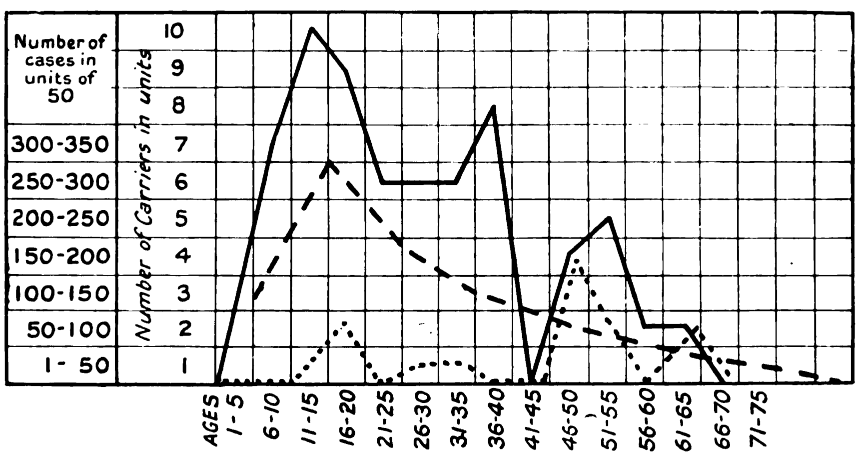
Name	Age	Onset	Date of examinations
M. D.	29	March 1, 1915	Positive on these dates, April 14, 1915, and six times positive after last examination, July 25, 1915
L. D.	46	February 27, 1915	Positive May 8, 1915, and six times to July 15, 1915
P. W.	46	March 3, 1915	Positive May 4, 1915, and eight times to August 18, 1915
S. P.	60	February 14, 1915	Positive April 25, 1915, and five times to July 25, 1915; intermission for three weeks
L. V.	35	December 23, 1914	Positive March 30, 1915, and eight times to July 25, 1915
E. V.	48	February 26, 1915	Positive May 4, 1915, and six times to August 19, 1915
E. P.	53	(?)	Positive May 27, 1915, and six times to August 18, 1915
V. V.	50	May 1, 1915	Positive June 11, 1915, and five times to August 19, 1915

Males.

G. D.	19	February 19, 1915	Positive May 27, 1915, and ten times to July 21, 1915
M. D.	16	April 6, 1915	Positive June 4, 1915, and ten times to July 21, 1915
C. D.	49	April 1, 1915	Positive June 4, 1915, and ten times to July 21, 1915

It is not possible to give the exact number of women over 40 admitted to the hospital, but of eight hundred and ten cases who probably had enteric, forty-three per cent were women, and if that percentage holds good it would appear that there were eighty-six women over 40 who had suffered from enteric, as there were just two hundred admissions over that age. Among these eighty-six were found six chronic carriers, and among the two hundred and seventy under the age of 40 only two were shown to be permanent carriers.

Curves are attached showing the age-incidence of the epidemic, the figures being for the nine hundred and twenty-seven admissions, the age-incidence of temporary and of chronic carriers.



Curve to show age-incidence of epidemic — — — — — —
Curve plotted in units of 50, age-periods 5 years.
Age-incidence of temporary carriers ————
Curve plotted in units, age-periods 5 years.
Age-incidence of chronic carriers ....
Curve plotted in units, age-periods 5 years.

In conclusion, we have to acknowledge our great indebtedness to medical officers of the hospital, who did all they could to help us.

METHODS OF EXAMINING THE VISION OF RECRUITS AND SOLDIERS, WITH SPECIAL REFERENCE TO ASSUMED AND REAL DEFECTS.

By Lieutenant W. WALLACE.
Royal Army Medical Corps.

[*In order to obtain uniformity in the application of tests of vision required in the Army, and in the method of recording them, the following outline is provided for the guidance of medical officers.*]

This memorandum has been drafted as the result of the experience gained in testing the eyesight of a large number of men who have already entered the Army or who have presented themselves for enlistment.

Uniformity in the method of examination being essential, the notes that follow deal with the tests (*a*) for recruits, (*b*) for soldiers, and (*c*) for those who wish to evade military service on account of assumed or existing defects of vision.

Test Types.

It is unnecessary to enter into the mathematical and optical calculations upon which the test types in use have been drawn to scale: it is sufficient to say that their universal adoption confirms their being convenient for providing an easy means for estimating the visual acuity. It may be noted, however, from the point of view of accuracy, that some published sets do not adhere to Snellen's formula. They are more difficult to read, and as they are invariably covered with a varnish which catches the light and renders them invisible at certain angles, they are all that a malingerer could wish. In practice, however, and for military purposes they are all accepted as a standard.

A set of test types consists of seven sizes of types numbered, from the largest, 60, 36, 24, 18, 12 (sometimes 10), 9 (sometimes 8), and 6, respectively, these figures representing the distances in metres at which the various sizes can be read by the normal eye with relaxed accommodation. Thus the normal eye can read No. 60 at 60 metres, No. 36 at 36 metres, and so on; but as it is impracticable to test vision at these extreme distances, a standard distance of 6 metres has been fixed from which the types are to be read. The vision, then, is recorded by a fraction in which the

numerator denotes the distance and the denominator the size of type. Thus when V. $= \frac{6}{6}$, the fraction signifies that at a distance of 6 metres the tested eye reads the size of type visible to the normal eye at that distance. When V. $= \frac{6}{12}$, the fraction signifies that the tested eye can only read at 6 metres what the normal eye can read at 12 metres. The fraction should not be reduced, as, for instance, from $\frac{6}{12}$ to $\frac{1}{2}$, but the numerator should always remain 6, except when the vision is less than $\frac{6}{60}$. In such a case it may be recorded as $\frac{5}{60}$ or $\frac{3}{60}$ or *less than* $\frac{1}{60}$, according to the vision under observation, the man walking towards the test types till he reaches a point when the largest letter becomes visible to him. The distance at which he stands from the test types is then approximately measured and entered as the numerator.

It is expedient that when the vision is $\frac{6}{60}$ or better, the distance of 6 metres should always be adhered to, for when the measurements are made at a distance less than 5 metres, accommodation may come into play, and $\frac{3}{9}$, for example, does not always represent a visual acuity of $\frac{6}{18}$, but frequently something less.

Some test types have a line numbered 5. This is employed for tests of extreme accuracy, the visual acuity of a man reading this line being recorded as $\frac{6}{5}$, amounting to $\frac{1}{5}$ above normal. It does not mean that the distance of 6 metres is to be reduced to 5.

The distance of 6 metres is easily marked off by an ordinary walking-stick, which is usually about a yard long. The test types should be placed in a good light, preferably against a dark background. The man's eyes should not face any light directly. When an electric lamp is used as artificial illumination it is best placed below the card, for the smaller letters need the brighter light, and although the strength of artificial light may be constant, it will be found by experience that the types under these conditions appear sharper on a dull day than on a bright one.

The Examination.

In order to guard against the types being learned by heart, it is advisable that the recruit should stand in such a position during his physical examination that he is unable to see the types. As visual defects are in many cases a primary and definite cause of rejection, it may save time to carry out the test of vision first of all, before the recruit strips. Too much credence is given to the possibility of a man, drawn for the most part from a not too highly educated class, being able to commit to memory in a few minutes the letters on the card. The contingency, however, has always to be borne

in mind in those cases in which there have been frequent visits to eye hospitals, with the opportunity for memorizing the letters during the application of trial glasses.

To obviate a risk of this kind the medical officer may ask the man to read from the right-hand side, or he may prepare confusion types by cutting up two or three sheets of test types and pasting them irregularly on a millboard, not forgetting to turn a few upside down. The man should not be trusted to cover one eye with his hand. A card should be held against the side of the nose and cheek, each eye being tested separately.

It has to be borne in mind that visual tests in the Army are on a footing totally different from those in civil life. In civil practice the patient seeks advice because he has, or imagines he has, a visual defect, and is only too anxious to assist the ophthalmologist. In military practice such cases are not so numerous, the tendency being rather to baulk the examination so as to gain relief from disagreeable duty or to evade service. This will be discussed more fully under Malingering.

Standards for Recruits.

According to War Office Letter 27/Gen. No./4583 (A.M.D.2) the following minimum standards of vision are prescribed for recruits:—

(*a*) R. $\frac{6}{24}$ or better. L. $\frac{6}{24}$ or better.
(*b*) R. $\frac{6}{24}$ or better. L. $\frac{6}{60}$.
(*c*) R. $\frac{6}{60}$. L. $\frac{6}{24}$ or better.

The man is "fit" if he passes standards (*a*) and (*b*). He is "fit" for the R.A.M.C., A.O.C., and A.S.C., and as a driver of the R.A. and R.E., if he passes standard (*c*).

Note.—Some latitude is being allowed at the present moment in the acceptance of men who are blind of one eye, but are fit in other respects.

With the above table in his mind, the medical officer should have no difficulty. His responsibility ceases if the recruit's vision can be classified by it, but in cases which are just below the minimum standard or on the border-line, he is at liberty to consult an eye specialist in the Royal Army Medical Corps, if one is within reach. This is a point of some importance morally and financially, for a man after enlistment may base his claim to be discharged from the Army on account of visual defects which existed before he was attested.

The specialist's opinion guards against this, and his report, drafted before the recruit was sworn in, should be pinned to the Medical History paper (Form B, 178) for future reference.

The minimum standard required by the War Office is so low that many men are able to reach it in spite of actual defects, and it is impossible, without the co-operation of a specialist in every case, to exclude those whose vision is bound to get worse on account of morbid conditions which already exist. Manifestly this assistance cannot always be at hand. It is right, therefore, to point out that each of the above standards can be passed by men of a desirable age, *e.g.*, from 21 to 35 years, who nevertheless have corneal or lenticular opacities, vestiges of iritis of old standing which is more or less stationary, or progressive diseases such as retinitis pigmentosa, disseminated choroiditis, and other affections of the fundi, degenerate in character, which will tend gradually to get worse. Graver lesions, such as incipient optic atrophy, albuminuric retinitis, or the premonitions of glaucoma, are not, as a rule, met with in the average recruit. The possibility of their occurrence, however, is not to be overlooked, especially among men who have already served their time in the Army, and a searching examination of the fundi in these cases may detect obvious disturbances.

These are purely objective to the ophthalmologist; but where he has to exercise the utmost discretion is in cases of refraction without degenerative changes. It has been ascertained by practical tests that a considerable error of refraction may exist without the vision being reduced below the minimum standard. Here expert knowledge is of advantage. The alleged vision is, for instance, below the minimum, say $\frac{6}{36}$, but by means of the ophthalmoscope the refraction is estimated approximately as lying between + 1 D. and − 1 D.; astigmatism may be present, either hypermetropic, myopic, or mixed, but with a normal fundus, and no strabismus present, it is unlikely that the alleged vision is as low as is stated.

The medical officer, therefore, has to use his own judgment when there is not an ophthalmoscope or set of trial glasses at hand, and if the recruit satisfies all the other tests for fitness it is safe to pass him even if his alleged vision is slightly below the minimum standard. The recruit will then be enlisted, and, subject to the ophthalmologist's report, he will be utilized in some capacity in the Army, although his fitness for musketry is doubtful.

NOTE.—Although retinoscopy by the direct method is not encouraged from a clinical point of view, it has the advantage of being carried out rapidly, and by its means obvious errors of refraction can be detected. In a case of high myopia, for example, it is not necessary to determine the error exactly, so long as it is ascertained that the man's statement is upheld by the approximate measurement. It is not the business of the medical officer to work out minutely the refraction of a recruit. He need only satisfy himself that the condition of the media and fundus or the refractive error confirms the alleged vision.

Standards of Vision for the Soldier.

The foregoing applies to visual tests before the recruit is sworn in. We have now to consider the vision of the soldier.

At the outset all affections which may be classified under the comprehensive term of "external diseases," such as affections of the lids, lachrymal apparatus, conjunctiva, cornea and iris, may be eliminated. We are here concerned with visual defects which cannot be assigned to obvious causes. In older days, when diagnostic methods were less delicate, many a soldier was branded as a malingerer because the visual defect was not apparent to the unskilled observer; and it cannot be denied that great hardship was incurred by many owing to lack of knowledge on the part of those who had to deal with them.

These severe conditions have now ceased to exist owing to specialists in ophthalmology having been appointed at military centres, and the vision of the soldier is now examined as minutely as any other of his physical functions.

A great deal of time will be saved and attempts to impose upon the medical officer will be checked if an entry is made in the soldier's Field Service Pay-Book of his vision and the refractive error. This should be done in accordance with the instructions of War Office Letter, 24/G.N. 3999, A.M.D. 3. When a man knows that his vision is stated in his Pay-Book he will be less ready to plead a visual defect, and this to a large extent will put a stop to the practice of producing a broken pair of glasses as evidence of impairment of vision.

The utmost discretion should be exercised by the medical officer in telling a man what is the matter with him, for he may trade upon the statement, as will be shown later in reference to the case of Private H., 3rd Essex Regiment. It goes without saying that on no account should the name of a disease of the fundus be mentioned without an ophthalmoscopic examination. If a man picks up a phrase like "concussion of the retina," he may evade duty for weeks; and soldiers who have returned from the Front and have been under shell-fire are not slow in discovering that in certain circumstances the vision can be definitely impaired without any wound having been received.

In the absence of a report from a specialist at the base hospital from which the man was discharged, his statement as to the actual conditions of his active service, or the ailment for which he was treated, should be received with caution. There may be direct evidence of "concussion of the retina" or absolutely none at the

time of examination; months may elapse before gross changes appear, and during this period the man may be excused duty on the strength of a hasty diagnosis made under circumstances which precluded a searching examination.

Many difficulties have been created by civilian practitioners, who, in good faith but at the same time in ignorance of the requirements of the Army, have inadvisedly been induced to grant certificates of disability to men perfectly competent to discharge their military duty, and these certificates have been forthcoming on all occasions to discount the report of the regimental medical officer. It should be clearly understood that as regards his vision no man, whether undergoing or about to enter upon military service, should be supplied with any written statement as to his eyesight beyond his bare visual formula.

Eyesight for Musketry.

When a soldier reports "morning sick" on account of eyesight, his statement almost invariably is that he was "sent off the range by the musketry instructor." In some instances, particularly when a batch of men from one regiment present themselves for visual tests, the "cause of the disease" is not forthcoming, viz., the musketry instructor himself.

Visual training, as laid down in the military text-books, is of paramount importance in all its grades, but the purely elementary stage is neglected. The soldier, in fact, is not taught to think for himself. He leaves too much to his rifle, and in his first steps in musketry his instruction is concentrated more upon the mechanism which is placed in his hands than upon the faculties which have to control that mechanism. When a series of manual acts has to be carried out by a small body of men, chosen on an average of physique and not of intelligence, uniformity of precision cannot be obtained at first. Even in times of peace, when men were recruited with a high standard of physique and vision, something more than accuracy of sight was required. Much more, then, during the pressure of war-time, when defects are overlooked, is patience necessary when men of varying mental ability are collected together.

Visual failure at the range may be deliberate or unintentional. In each case the specialist may be asked to report, but in many instances the failures are due, not to vision, but to the method of instruction.

A man should be taught that his eyes have a focussing power, and that it is impossible to see backsight, foresight and target

simultaneously. This can be demonstrated by means of a dummy rifle with slots in the position of backsight and foresight, into which letters drawn to the Snellen scale can be slipped.

A practical test can be contrived from the cards of the scale of the first class figure target. The smallest of these at 15 yards represents the figure target at 500 yards. At 6 yards, or 6 metres, it represents the same target at 200 yards. As the outline of the figure on the smallest card is approximately the size of the A of Snellen $\frac{6}{6}$, the man who declares that he cannot see the target at 200 yards, although his V. = $\frac{6}{6}$, is obviously making a mis-statement.

It will not be time wasted if the ophthalmologist exercises a little patience in explaining to the young soldier a few elementary points in visual training in relation to the use of the rifle, even although the matter is not quite within his province.

It will be gathered that the large question of *attention* is involved in the foregoing. It came into prominence in the case of a signaller of four years' service, whose statement was that he was unable to identify the "dots" of the code, although his V. was $\frac{6}{6}$. He was advised to practise with a friend, beginning with clearly spaced movements gradually increased in speed.

Malingering.

Every soldier knows that eyesight is essentially necessary in his business, and that visual defects, whether genuine or feigned, may often relieve him of irksome duty. It is imperative, therefore, to distinguish between actuality and pretence, and to treat each case according to its merits.

Moral and Economic Considerations.

This opens up the vast and far-reaching question of malingering, which in the Army, as in civil life, has two aspects—the moral and the economic. In civil life the question of "common honesty" is not so important, for there is not that community of interests, that co-operation of individuals towards a single end, which are the basis of military concerted action and discipline. In civil life, further, the malingerer, as a rule, has a material object in view; arbitration, compensation, insurance claims and costs of all kinds against corporate bodies, have their allurements, and the speculating attorney, with his own share in prospect, does not hesitate to magnify the importance of the occasion. In civil life, however, there is this substantial difference, that the malingerer, or, as he would prefer to be termed, the plaintiff, has time to get up his case

and be coached as to the right and wrong kind of symptoms, and it is unlikely that he will enter the witness-box without having at his finger-tips an answer for every question as to the known and nearly all the unknown manifestations of his disease.

Malingering in the Army carries itself with a somewhat different air, but the responsibilities of citizenship are unchanged. Discipline has just been mentioned, and in the Army this is communal rather than individual. This is not to say that individual tendencies can be ignored, for the microbe of insubordination may rapidly permeate a battalion; but for the most part, according to Army ways, discipline disciplines the undisciplined.

At the same time, the economic aspect of malingering, which in the case of the private citizen does not seriously affect the State, comes home very materially in the case of the soldier. The workman who succeeds in obtaining his damages is disposed of, and he has the rest of his life for considering whether his action was wise or foolish. His claims have been settled not by the State invariably, but as a rule by some private individual or corporation. Not so in the case of the soldier. On an uncorroborated plea or a false issue he may burden the State with claims and pensions till the day of his death, and therefore it is of supreme importance that his sphere of operations should be strictly delimited.

Tests for Malingering.

The tests of malingering described in the text-books are for the most part applicable only to those cases in which a plea of total blindness in one eye is advanced. Not unusually there is a claim for compensation or damages, based upon the assertion that the sight of one eye is lost. This state of affairs seldom engages the attention of the medical officer, for the average recruit or recently enlisted man is not quite in the position of the workman who has met with an accident and is determined to make the most of it.

In the Army, eyesight is not the only physical function that has to be investigated, and under a voluntary system there is nothing to be gained from a recruit who first of all wishes to enlist and then withdraws by declaring that one eye is blind. He is still a free agent and can be charged only with wasting the recruiting officer's time. Once in the Service, however, he comes under observation and discipline; his movements can be watched and his assertions verified.

In the orthodox tests for alleged total blindness in one eye, *prisms* are used in the following ways :—

(*a*) A prism base downward is placed before the good eye while the man looks at a distant light or candle. If he sees two candles, binocular vision is proved.

(*b*) A prism of 10° with the base outward is placed before the "blind" eye. If there is any sight in this eye diplopia will be produced, and the eye will move inwards to correct it and fuse the two images.

(*c*) The "blind" eye is covered. A prism of 10° with the apex upward is placed before the good eye in such a position that its apical edge lies horizontally across the centre of the pupil. This produces monocular diplopia. The prism is then moved upward so as to be completely in front of the good eye and the "blind" eye uncovered. If diplopia is produced or admitted, there is sight in the "blind" eye.

This test may fail owing to the difficulty of placing the edge of the prism in position without some preliminary adjustment, during which the man may be on his guard from having seen single at one moment and then double through the same glass. It demands intelligence and accuracy on the part of the patient, and by reason of these may defeat its object.

Test with Coloured Glasses.—This consists of fitting a trial frame with a plain red and green glass, and asking the patient to read a row of red and green letters. The red letters will be invisible to the eye that has the green glass and vice versa, but if all the letters are correctly read, irrespective of their colour, there must be sight in the "blind" eye.

The Action of the Pupil also must not be overlooked, there being no movement when the eye is blind.

Tests with Trial Glasses.—A high + glass is placed before the good eye and a low + or − glass before the "blind" eye. If the distant type is read, the vision of the "blind" eye is good.

The Use of Mydriatics.—Some authorities speak of the instillation of a mydriatic into the "good" eye, to paralyse its accommodation and put it temporarily out of action for the purpose of studying the scope of the "blind" eye. It is extremely doubtful if this should be resorted to in the case of a man who is outside military jurisdiction, for the transient "blindness" which results may react on the uneducated mind and damage the cause of military service far beyond the value of a solitary recruit who is proved under atropine to be malingering.

It is unnecessary to point out that these tests are supplementary to searching examination with the ophthalmoscope and an estimate of the refraction, followed by confirmation of the optical error, if any is present.

In the Army cases are bound to arise eventually in which a man states that he has lost the sight of one eye. To these the foregoing tests will apply when there is reason to doubt his assertion.

The most common form of malingering takes the shape of a statement that one eye is imperfect, and the men pleading this disability may be divided into two classes :—

(*a*) Those who pretend to have an optical defect.

(*b*) Those who know they have an optical defect and trade upon it.

No hard-and-fast tests can be prescribed for the detection of these, for ultimately the issue is decided (if the battle is not drawn) by the alertness and ingenuity of the medical officer. He must in the circumstances regard each case as genuine until he has a clue.

Although there is no comprehensive term which will describe the malingerer, it is undoubted that there is something indefinable in his bearing which experience alone can detect. He may be self-assertive and over-confident; he may be hesitating and evasive. When he is talkative it is not good policy to stem the torrent at the outset, for the schemer is bound, sooner or later, to make a slip. When such a man is completely absorbed in himself and his "ailment," the medical officer has leisure to make his mental notes, and in a clear case of malingering the standard tests of vision may come last in importance as evidence. A study of the man's uniform, his smartness, even his trinkets, may settle the matter more decisively than any of the orthodox methods of examination. Marks on the bridge of the nose will testify to spectacles or a pince-nez having been recently worn. The man may experience discomfort without glasses and may wear them constantly, removing them, however, just before examination in order to make out as bad a case as possible.

These points have to be noted in cases in which no obvious external ocular defects are present.

Continuous and persistent blepharospasm is the commonest "complaint," and, in the absence of conjunctival or corneal lesions it should be challenged. Coloured spectacles, eye-shades of all

shapes and sizes, yards of bandage, are also suspect, but the medical officer would do well to regard them as part of the performance. An attitude of supreme dejection, or of intense suffering, is often of value, and an excessive display of sympathy on the part of the medical officer not infrequently elicits the sought-for clue. It is better, indeed, to make a quiet examination at first than to affect scorn or incredulity. The "sucking-dove" mood, with at the same time an eye for every casual and apparently trivial occurrence, will trap the most case-hardened sinner.

One matter should be insisted upon, and that is the appropriateness of the surroundings. The malingerer comes of a class that is easily impressed, and to examine him ophthalmoscopically with a makeshift lamp which is always breaking down, or to test him with apparatus obviously improvised, is merely to suggest to him that he is in the hands of amateurs who do not know their business. It has to be remembered that it is his point of view that has to be studied, and he will maintain his stubborn attitude to the last if he thinks that he can take advantage of the medical officer.

This was recently shown to be the case. An ophthalmologist took the vision of a large number of men under the "Derby scheme." A man whose eyesight was not up to standard was there and then examined with the ophthalmoscope *coram publico*. Those rejected on this account had incontestable defects, and there were no malingerers. On the other hand, of those sent to him by other medical officers for a leisurely and private examination, the majority were up to the standard but were reluctant to make the admission, while about twenty-five per cent were unquestionably malingering.

Blepharospasm is often affected, and if a warning does not suffice at the first visit, the man ought to be detained for observation. When ophthalmoscopic examination is refused or rendered difficult, the condition of the cornea should be noted; and if it is sound, the man should be cautioned.

An extreme case may be instanced. Driver R., R.F.A., was sent up for examination with a view to his discharge, the statement of disability being blepharospasm and nystagmus. What he was actually suffering from was a grievance against his former employers, Welsh mine-owners, who had refused him compensation for some alleged injury. While in a civil hospital he had picked up the names of various "diseases of occupation" to which miners are subject, and by constant practice had been able to simulate blepharospasm, and to impose upon the civilian medical

officer, who had accepted the nystagmus without further inquiry. When examined he successfully resisted all attempts to open the lids, and accordingly was detained for observation. Eventually he was caught playing cards at a time when the medical officer was least expected, and it was ascertained that neither blepharospasm nor nystagmus existed.

When functional blepharospasm is present without any lesion of the cornea, close investigation may frequently bring to light illiteracy or mental deficiency. This was found in a small group of men recruited from one remote district.

The danger of accepting a man's or any statement without a full examination may be further illustrated:—

Early in August, 1914, Private H., 3rd Essex Regiment, had some sand and earth thrown up in his face from a bullet striking the parapet of his trench. As the débris had gone into his eyes he was hurriedly bandaged and removed to a clearing station, whence he was immediately transferred to a military hospital in England. Owing to the conditions that prevailed at the time, no complete examination was made on admission; the statement on his tally was accepted and a message on an Army Form was sent to his wife, informing her that he was suffering from a gunshot wound of the right eye. Shortly afterwards he was dismissed cured, to rejoin his regiment.

Fourteen months later he was sent up for examination with the above history and with greatly impaired vision of the right eye, which was alleged to be under $\frac{3}{60}$; the left read $\frac{6}{36}$. There was no trace of any injury, the fundi were normal, and by the interchange of + and − lenses which negatived one another, the vision of each was brought up to $\frac{6}{9}$ with + 1·25 D. in each.

Malingering was therefore proved, but on the strength of the Army Form referred to, which he was clever enough to obtain from his wife and to produce on all occasions, he had succeeded in imposing upon everyone and evading duty for upwards of a year.

The Examination of the Malingerer.

It should be borne in mind that detection is more likely to result when the man is allowed to believe that his case is regarded from the first as genuine, and that his story is not discredited.

As he knows nothing about the relative size of the letters of the test types, but doubtless has been coached as to the *number of lines* that he has to read in order to come up to the standard, a special set of test types should be used. Instead of the single

top letter representing $\frac{6}{60}$, the scale should be rearranged so that it begins with the top letter $= \frac{6}{36}$, followed by two $= \frac{6}{24}$, then three $= \frac{6}{18}$, and so on, in imitation of the standard types. Thus the man who has been told that he can circumvent the test by seeing no more than the first two lines, and reads them, has passed the standard without being aware that he has committed himself.

It is best to take the vision for distance before the ophthalmoscopic examination, so as to obviate any complaint about the strong light having dazzled the eyes. With the ophthalmoscope the state of the cornea, iris, lens and vitreous should be noted. It is probable that the malingerer will resist the ophthalmoscopic examination by perpetually winking or rolling the eyes. In this event it is best not to waste time, but to caution the man that a report on his vision must be made, and then to postpone further examination till after the next few cases have been seen. This gives him the opportunity to consider whether it is worth while keeping up the pretence.

When the ophthalmoscopic examination can be made immediately and without coercion, the refractive error should be estimated approximately. If none of marked degree exists, and the media and fundi are clear, the relation between the alleged vision and the refractive condition furnishes an important clue. When, for instance, the alleged vision is $\frac{6}{36}$ and the error is about $+4$ or -3, the man's statement may be perfectly consistent: but when the defect cannot be accounted for objectively, and the vision is brought from $\frac{6}{36}$ to an admitted $\frac{6}{12}$ or $\frac{6}{9}$, by means of a low $+$ or $-$ glass, the alleged vision may be doubted.

The man is now provided with a trial frame. Sometimes this alone, without any lenses, effects a wonderful change in the vision, but as this generally is a consummation too much to be hoped for, a blank or a high $+$ glass is placed before one eye, and a $+ 3$ sph. before the eye to be tested. This makes the man myopic, and by means of $-$ glasses tried in series the myopia is reduced till the frame contains (for one eye) $+ 3$ sph. $- 3$ sph. $=$ *nil*. In the majority of instances this practice succeeds, and even if the vision is not brought up to $\frac{6}{6}$ by its means, it suffices to establish the fact that the man is malingering. It is to be remembered that for all units, excepting the Corps, an admitted $\frac{6}{24}$ in one eye and not less than $\frac{6}{60}$ in the other constitute the standard of fitness.

During this test the man's face should be closely watched and

every movement noted. He may say that a change of lens is no improvement before he has had time to read the line, or even before the glass has slipped into the frame. There should be no hurry, and if the medical officer is observant he may sometimes catch the man in the act of reading the letters *with his lips*, before insisting that he is unable to see them. The nature of the man's answers should be taken into account and considered in the light of the kind of reply that is given when a genuine refraction case is being dealt with. A determination not to see beyond a certain line, although the exact correction is placed in the trial frame, should be regarded with suspicion, and when it is clear that the man is not disposed to help he should be sent back to duty and re-examined two or three days later.

Such a test is purely diagnostic, and is carried out only to put the man's statement to the proof. There is no call to work out the refraction minutely, for the purpose of the test is attained if it can be shown that an alleged vision of $\frac{6}{36}$, which is just below the standard, can be brought a little above the standard by means of a low + or − glass, or by means of + and − glasses which neutralize one another. At the same time, if an indubitable error exists, the fact should be stated in the man's favour.

When the test with neutralizing glasses fails and the ophthalmoscope reveals a normal state of affairs, the medical officer has to fall back on his own ingenuity for devising tests, bearing in mind what was said above as to the ordinary methods not being invariably the surest means of detection. The tests with prisms are not applicable here, for there is not pretended blindness in one eye, but simply an alleged diminution of visual acuity.

The deliberate upsetting of the trial frame may give a clue to an unusual sharpness of sight when rimless lenses are picked up without hesitation from the floor of the dark room. Evidence may be forthcoming where it is least expected, as the following case will show:—

A man presented himself under the "Derby scheme" for tests of vision. He stated that he could only read $\frac{3}{60}$, and in order to do this resorted to various bodily contortions. The fundi and media were normal and tests with glasses failed. As the medical officer sat down to make his notes, the man, thinking the examination at an end, threw open his coat and thrust his hands into his trouser pockets. The medical officer caught sight of a number of cheap silver medals hanging from his watch-chain, and casually asked what they meant. The man replied that he had won them

in quoits competitions. This was sufficient, and the man was returned as fit for general service as far as his vision was concerned.

The cases in which detection is most difficult are those of men who have at some time or other attended the eye department of a hospital. If they do not know the test types by heart, at least they are familiar with the procedure of examination, and can describe their own condition fairly clearly. The majority of these have slipped into the Army at a time of pressure, and have a definite refractive error. Here experience must be the guide as to the probability of the vision being up to standard without glasses, there being the utmost diversity of statement as to this when the man is aware that he has a defect. The glass required does not always throw light upon what the uncorrected vision ought to be, for a reference to a large number of refraction cases shows singular discrepancies.

For military purposes the standard of $\frac{6}{24}$ is all that is required, and this may be the uncorrected vision of cases whose error ranges as widely as from $-$ 1D. cyl. to $-$4D. sph. or from + 2·5D. cyl. to + 6D. sph. When the man is willing to help, a good result should be obtained from the optical correction, but the malingerer, who has gone through the process before and knows what is expected of him, will not be induced to admit that glasses are of any use. He is best dealt with by assigning him duty of a particularly unpleasant nature, the reason being given that his work is consistent with the amount of his vision.

In refraction cases, and those demanding a minute and accurate examination, the impression on an ignorant mind may be the reverse of what the medical officer wishes to convey. It is not unnatural for an uneducated man to estimate the seriousness of his visual defect by the length of time devoted to his case. He cannot be expected to know, and it would be waste of time to explain to him, that many slight errors of refraction demand a greater degree of precision than those cases of astigmatism in which there is a marked difference between the two meridians, It is well, therefore, to recognize the possibility of a protracted examination leading the man to imagine that there is something unusual in his case, and the patience and attention given to him by a medical officer trained to make accurate observations may in themselves suggest a dishonest course of action.

Thus the efforts to render the soldier more efficient may defeat the end in view, and he may claim exemption from service, not from actual consciousness that he sees worse than his comrades, but from the fact that he underwent a protracted examination.

As far as the provision of glasses is concerned, a vision of $\frac{6}{18}$ uncorrected is not reckoned a drawback among the labouring classes, and often is preferred to a vision brought up to $\frac{6}{6}$ by means of glasses.

The man's occupation in civil life may have been one that could not have been followed without something more than average eyesight. This should be inquired into.

Diplopia.

Cases of malingering are occasionally met with in which the man complains that he sees double. These must be investigated as if they were genuine, with the application of the tests described in the text-books, and with every precaution taken to guard against a serious nervous lesion being overlooked. Much depends upon the intelligence of the man under examination, even when there is no attempt to impose upon the medical officer; and contradictory statements may be made in good faith by those whose powers of description are not on a high level.

It is unlikely that the average person will take the pains to study or even to understand the various manifestations of diplopia, and sooner or later the malingerer is bound to commit himself under a close examination or to break down altogether. He may, for instance, adhere to his assertion that the false image is always vertical and the true image always oblique; the "false projection" test cannot easily be imitated; but as these cases are not urgent there is time for a study of the previous history and for subsequent observations. A certain brusque incredulity when the man overstates his case will put an end to the matter in many instances.

When a man who at one time has suffered from diplopia, maintains that it is still present, it is extremely difficult to disprove his assertion, for if his case has formerly been at all carefully investigated, and if he is a man of observation he will never be at a loss for an answer. He will rely upon his memory, and as it is unlikely that he will readily forget the disconcerting visual disturbance that gave him so much annoyance, he will draw upon his past experience for his symptoms. Too much attention should not be given to the standard tests; more homely devices should be resorted to, such as making the man go up and down stairs with the "good" eye closed, or asking him, again with the "good" eye closed, to name a playing card and to pick it up from the table without hesitation.

When there are strong grounds for doubting the man's statement, and when the existence of graver lesions has been excluded, the safest treatment is none. If he is malingering, he will not undergo any inconvenience; if he makes his complaint in good faith, the consistency of his answers and his anxiety to get well will decide the question.

Glaucoma.

It is unlikely that a soldier will know enough about affections of the eye to assert that he has glaucoma when none of the typical signs is present. Detection in a case of this kind is simple. But a case may arise in which a man has been operated upon for the disease, and having once been so seriously affected as to require surgical interference, he will describe the symptoms exactly. He may declare that he has lost the sight of one eye: there may be increased tension with cupping of the disc, but without any implication of the cornea or iris, and miosis may be readily produced. No small responsibility rests upon the surgeon who has to decide whether to accept the man's statement, with the possibility of further operative treatment in view, or to consider it in the light of an oft-repeated story. In the absence of objective concomitant symptoms, the relief of tension under eserine should put the medical officer on his guard, and the man's previous medical history should be followed up.

Optical Defects existing before Enlistment.

Apart from refraction cases, there is a group which, although not classified strictly under malingering, may nevertheless develop into fraud. Of these the medical officer may be called upon to give an opinion as to the probable date when the visual defect arose. To quote an instance, a man was sent up for examination with a view to his discharge. He had been in the Army while between the ages of 19 and 23, and had rejoined when over 40. His vision was below the minimum standard, and the defect was due to old iritis, which he asserted had been contracted during his later period of service. Although the pupils were small and partially blocked, he denied all recollection of having had an acute attack of inflammation, but this assertion raised suspicion. Homatropine and cocaine were instilled, and the pupils yielded sufficiently to give a view of the fundi, which were seriously affected with choroiditis, probably of specific origin. As his second period of service was only ten months in duration, it was extremely unlikely that the iritis

was of so recent date, and this conclusion was strengthened by the presence of choroiditis. Had this man's "disability" been allowed and passed, he might have claimed a pension for having been incapacitated while in the Army; the public would have been defrauded, and on the strength of his discharge on account of defective vision he might have entered upon a career of deception.

Similar instances might be given of serious lesions of the fundus and of incipient cataract which, if they had gone undetected and unrecognized at the recruiting stage, might have been used eventually as grounds for claims on the public purse.

Serious Optical Defects with nevertheless Good Vision.

The last group of cases to be considered here consists of those in which a grave lesion exists without a corresponding defect of vision. The man may complain of some apparently slight and trivial symptom, and may be dismissed as a malingerer because no gross error is detected by the test types. Here in particular the medical officer must be on his guard against hastily condemning any man for pretended loss of vision until he has satisfied himself of his proofs.

Corneal and lenticular opacities, traces of old iritis, and affections of the vitreous and fundus give definite evidence of impairment of vision with the ophthalmoscope. In the following instances the impairment was slight and the men's statements at first appeared doubtful till the ophthalmoscope discovered the actual conditions.

(1) Private M., Suffolk Yeomanry, reported sick because he said he could not see in the dark, a common form of complaint among men wishing to be excused night duty. There were some grounds for disbelieving his story, for his vision was given as $\frac{6}{12}$ and $\frac{6}{18}$, a not unlikely under-statement for a malingerer. But on inquiry it was found he had to be led if he was away from his quarters after nightfall, and the ophthalmoscopic examination showed retinitis pigmentosa in each eye so typical that his "present condition" would have been accurately described by quoting the description of the disease given in the text-books.

(2) Serjeant F., 3rd Loyal North Lancashire Regiment, lost his right eye from injury by fragments of a bullet which had splintered on striking the parapet of his trench. Three days later the eye was excised. At the time of injury the vision of the left eye was very imperfect, but gradually returned, and when he appeared before a Medical Board, seven weeks later, he was passed and

sent back to his regiment, without, however, an ophthalmoscopic examination having been made. Seven months later he presented himself for further examination, complaining of occasional dimness in the remaining eye. His vision was $\frac{6}{6}$ partly, and this acuity doubtless had justified the Medical Board in their action.

On ophthalmoscopic examination, a large area of choroiditis with masses of pigment was found at the extreme nasal side of the fundus. The disk was hazy at its upper margin, and, below it, there was a white linear area, to the outer extremity of which was seen a small roundish fragment of metal adherent to the retina. No scar was perceptible on the sclerotic at the point corresponding with the position of the fragment, but the man stated that ten days after the injury small pieces of metal had been removed under a local anæsthetic from the conjunctiva.

It is questionable if the choroidal disturbance would have presented definite features as early as seven weeks after the injury, but the presence of the foreign body was beyond all doubt. Unfortunately the man, who had come from a distance for examination, disappeared before an X-ray plate could be made. The bare record of the visual acuity in this case gave no clue to the actual conditions present in the fundus.

Case 3 is somewhat similar. Private L., R.A.M.C., was injured in the face by a detonator which burst while he was examining it. There was a slight wound of the left upper eyelid; no injury of the cornea. The vision of the right was $\frac{6}{6}$, of the left $\frac{6}{9}$. When examined eleven days after the injury, he complained that occasionally he saw a shadow with the left when looking to the left side. There was no irritation of the eye and the pupil was active. Without an ophthalmoscopic examination this man would have been advised not to look to the left side and dismissed without further ado, but on close examination there was unquestionably a fragment of brass (part of the casing of the detonator) suspended in the vitreous to the temporal side of the pupil, and its presence was confirmed by a skiagram.

It may be argued that the cases cited are extreme instances, but at the present time most cases run to extremes, and it is for the unusual and incredible that the medical officer must be prepared.

Enough has been said here to aid the medical officer, and it cannot be emphasized too often that in his general duties, and not alone in the sphere of ophthalmology, fitness in the soldier, when carefully studied, means economic as well as physical efficiency.

"TRENCH FEVER.": A RELAPSING FEVER OCCURRING WITH THE BRITISH FORCES IN FRANCE.

By Captain J. W. McNee

and

Lieutenant Arnold Renshaw.
Royal Army Medical Corps.

with the clinical assistance of

Captain E. H. Brunt, M.B.
Royal Army Medical Corps.

Note by Colonel Sir Wilmot Herringham.

During the whole time that the Army has been in Flanders, cases of short fever have continually occurred.

In a comparatively small number there has been a little bronchitis, or some diarrhœa, or tenderness of the muscles or nerves in limited situations. These have been called bronchitis, or influenza, enteritis, colitis, myalgia, and neuritis. But as a rule the symptoms have not included more than the general aches and pains which are the common denominator of all fevers. The patients have been very slightly ill, and except in a small number of cases have quickly returned to duty.

It has been very difficult to know what to call these cases. They have been sent in as influenza, myalgia, neuritis, pyrexia of unknown origin, and even as rheumatic fever. Of genuine rheumatic fever I have seen only three instances. Its absence has been one of the most striking things in the campaign, and effectually disposes of any connexion between this fever and wet or cold.

These undetermined fevers have from the first been the hunting-ground of the bacteriologists who with their laboratories are disposed in a line along the front, together with a few in special places farther back. The bases have of course their own bacteriologists and are not now under consideration.

The diagnosis of the enteric group of fevers is of such consequence to an army that the first task of the bacteriologist is always to exclude them. In consequence these cases of pyrexia have throughout been examined from that point of view. As they were usually seen quite early in the disease, cultivation of the blood

has been practised regularly, but cultivation of the excreta and agglutination tests have also been carried out in many hundreds of cases. In any case where either abdominal symptoms, or a dry tongue, or an enlarged spleen, or suspicious spots gave clinical grounds for suspecting an enteric fever the patient was sent down as "suspected typhoid" even if the bacteriological evidence was absent. But after all this had been done we were left with a large mass of cases in which neither the clinical nor the bacteriological evidence afforded any ground for this diagnosis.

In the early part of the summer Major J. H. P. Graham called my attention to a type of fever characterized by two bouts of pyrexia separated by a normal interval. He afterwards published two cases of the kind (*Lancet*, September 25, 1915). About the same time Captain Wells reported several similar cases. Colonel Sir William Leishman came round with me to see these cases. Their resemblance to sand-fly fever, and also to dengue, struck those who had had experience in these fevers, but there were several points which effectually disproved identity. Other officers were good enough to look out for similar cases. I should like especially to thank Captain Stirling and Captain Bolus for their help. In the *Lancet* of November 20, 1915, appeared a paper by Captain G. H. Hunt and Major A. C. Rankin, describing thirty cases, and mentioning for the first time the name "Trench Fever," which by this time has come into common use. From these papers and from the paper now published I think we can say that from the mass of cases of obscure fevers one type has been isolated, in which the clinical symptoms, the course, and to a certain extent the pathology, have been established. We are, however, still ignorant both of the nature of the infection and of the way in which it is introduced into the human system. It is still occurring, and this, I think, disproves the agency of any flying insect.

The present paper needs no praise of mine, but I may say that I have followed the work throughout with the deepest interest.

The cases of the type to be described first began to be recognized in this laboratory area about the beginning of July, 1915, although on considering the matter later it was certain that a small number of men seen during the previous month had suffered from the same disease.

It will be of interest to give an account of how our attention was drawn to the condition in the first place. In the first few days

of July a number of men, about twenty in all, were sent in to an isolation hospital labeled "suspected enteric." These men all belonged to a division which had recently arrived in the area, and all had headache and varying degrees of pyrexia in addition to other symptoms to which less attention was paid at the time. Since it was known that during the previous two months cases of paratyphoid B had occurred both in the civilian population and in the division then in occupation of the area, it was at first thought that these new cases might be of the same nature. Blood cultures were made in bile salt broth in the usual way, and thereafter the cases were immediately transferred to a stationary hospital farther from the front. These blood cultures proved one and all sterile. The men reached the stationary hospital within a week of the onset of the febrile symptoms, but on admission there their temperatures were either found normal or fell to normal within a day or two, leaving the patients apparently quite well. As the cases did not resemble clinically any of the enteric group, an inquiry was at once addressed to this laboratory to find out the results of the blood examinations. The bacteriological and clinical findings thus seemed to exclude the enteric group, although the possibility of previous inoculation modifying the course of genuine enteric had still to be considered at the time.

Cases of the same kind occurred immediately afterwards, and on these being watched it was found that the fever ceased after five to eight days. These men were examined carefully, and other symptoms recognized, which will be described in full later on. None of these early cases, however, remained under observation for long after the temperature fell to normal, so that their subsequent history is unknown. The point of this remark will be seen when the course of cases watched over a long period is considered.

As has been already indicated, all the early cases remained under suspicion of belonging in some sort of way to the enteric group. As more and more cases were observed, however, each with a similar and constant group of symptoms, the disease soon became recognizable as a definite clinical entity, and early became known to officers and men under the name "trench fever."

Since attention was attracted to the condition, great numbers of cases have come under our observation. During the months of July, August, and September, in fact, it was impossible to visit three or four field ambulances on any day without seeing at least half a dozen fresh cases.

During August and September arrangements were made, especially at one casualty clearing station, to keep a series of cases under constant observation for some weeks, as a result of which we have been able to carry out most of the clinical, pathological, and experimental work detailed below.

Distribution of the Disease.

The cases have been met with, curiously enough, only among two classes of men; namely, those direct from the trenches, or at least from near the trench zone (artillerymen, etc.), and men of the Royal Army Medical Corps. On looking into our records no real exception can be found to the above generalization. Thus in our experience only those who have actually lived in or near the trenches, and those who by reason of their work are constantly in contact with sick and wounded men from the firing line, have suffered from this disease. This seems important in searching for the means of transmission of the malady, and shows at any rate that the name "trench fever" is not without some justification.

No case has been met with in units such as Ammunition Columns, Ordnance, Headquarter Troops, etc., which although in the Army area are situated at some distance from the lines. Of the Royal Army Medical Corps units the personnel of both Field Ambulances and casualty Clearing Stations have suffered. No stationary or general hospitals being in the zone of the laboratory, we are unable to speak of them.

Age and service, foreign or otherwise, have had no influence, both old soldiers and newly joined men being equally involved. Officers and men, too, have apparently been affected in the same proportion.

It is important to observe, also, that in a Casualty Clearing Station, where a room was specially set apart for the observation of such cases, four of the orderlies developed typical attacks of the disease. Other men affected in the same unit included the attendant of the incinerator, the man in charge of the Thresh disinfector, an officer's cook, as well as other men on ordinary duty. The question of the occurrence during the past summer of a similar disease among the civilian population has been gone into, and although it is difficult to get sufficient accurate information, it seems highly probable that such cases have existed.

In the course of inquiry some interesting particulars of the

types of fevers found in the Flanders area have emerged, but no help has been gained with regard to a past history of this disease.

Types of Fever.

Two types of fever will be described, and at first it was quite impossible to be certain whether both were varieties of the same disease, or were two distinct entities. When the experimental work comes to be dealt with, however, evidence will be given, which to our mind makes it practically certain that one disease alone is under consideration. Both types have identical symptoms, and the initial history of both is essentially the same. The cases only differ in their course, and that in a very curious and interesting way.

Class A.—The patient as a rule feels suddenly ill; headache, dizziness, and pains in the lower limbs being the most constant initial symptoms. Some men give a history of having been so suddenly overcome by headache and dizziness that they fell down in their trench. The headache, although always severe, is not constant in its seat of maximum intensity in different cases. A very common feature, however, is pain behind the eyes, especially when they are moved. Pain appears early in other places besides the head, the most common sites being the lower limbs, and small of the back. In the former the pain may be confined to the "shins," but is often present in the thighs and behind the knees. It is difficult to say whether the pain is periosteal or muscular or both, but all the men state that it feels deep seated in the limb. It often gives rise to an intense feeling of restlessness, so that the patient is unable to keep his legs still for any length of time.

No diarrhœa is ever present, but on the contrary a tendency to constipation is frequently observed.

The fever varies in intensity, ranging up to 103° F. or 104° F. in the first day or two. The face is flushed, the eyes generally clear and bright, and free perspiration occurs. The tongue is furred, and there is great loss of appetite. No signs of catarrh are ever present in the chest. The pulse-rate is only slightly raised, a common figure being about 100. Often about the third day there is a sudden drop of the temperature to normal or even subnormal, without abatement of the symptoms. Thereafter, however, the temperature rises at once, to fall again, in our experience, about the sixth to the eighth day. In other cases, however, there is no such intermission, the temperature remaining continuously elevated for a week. When the temperature drops at the end of this

period, there is an immediate relief from all the symptoms, which is very striking. The rate of convalescence varies, and in many of these cases, but not in all, is complicated by a single relapse. This is in contrast to the second type of case to be described, where the initial period of fever is not so long, and relapses frequent. It seems as if, granting that the same disease is under discussion, a longer initial attack may give rise to only a single relapse, whereas a shorter period of fever at the beginning may be followed by several relapses. Enough evidence has not yet been accumulated to render this supposition certain, but we wish to suggest as additional evidence in favour of the disease being a single one that the duration of the malady with its relapses may be inversely proportional to the severity and duration of the initial attack.

The relapse is met with as a rule within four days of the temperature falling to normal. The fever is never very high, reaching perhaps 100° F. to 101° F. The duration is one or even two days, and during this period all the previous symptoms return, although with lessened severity.

A series of nine charts, all from cases of the type described, is given below. It seems superfluous to give a clinical account of each example, so only points of special interest will be alluded to in the text.

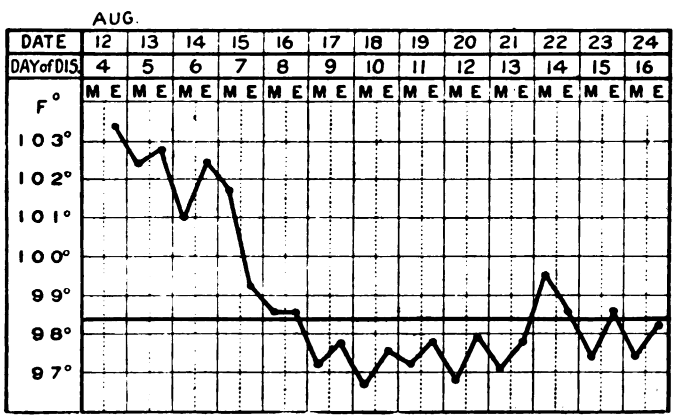


CHART 1.

This man was admitted on the fourth day of illness. A typical single relapse is shown.

Chart 2 shows in part the tendency to remission often seen about the third day. The relapse is more gradual and prolonged than in the first chart.

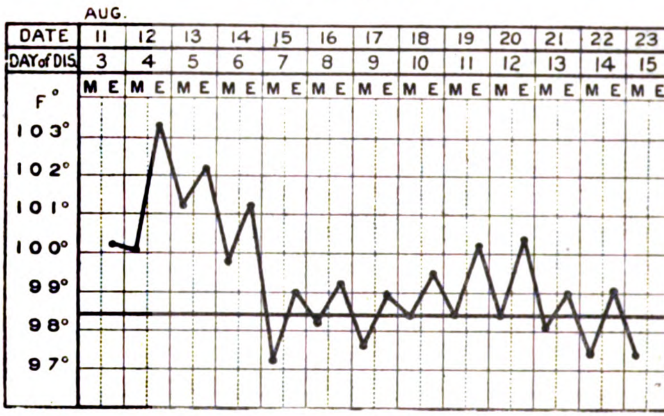


CHART 2.

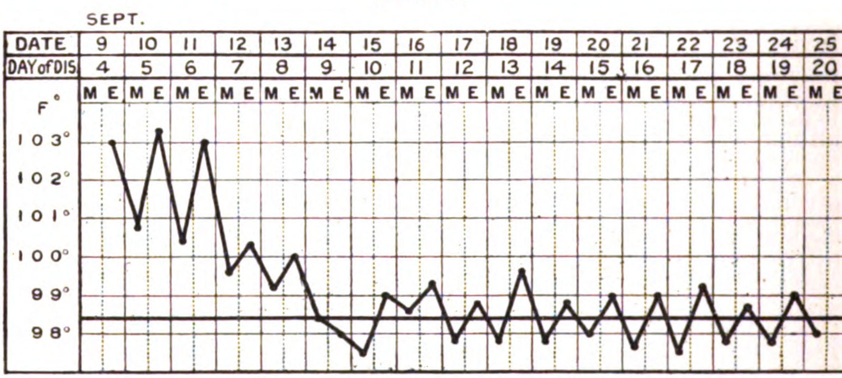


CHART 3.

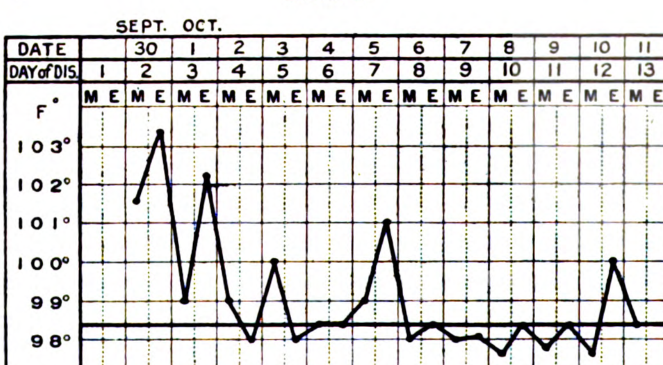


CHART 4.

This chart shows a more irregular type of fever. The patient was admitted on the second day of illness. The symptoms continued until the eighth day, after which a relapse occurred on the twelfth day.

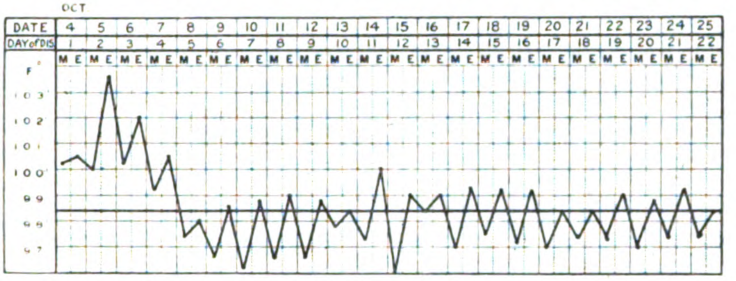


CHART 5.

This man had been slightly wounded in the shoulder, and came to the convalescent hospital with a normal temperature. The chart, therefore, begins on the first day of the attack. He had not been, when the illness commenced, in the ward where the other febrile cases were kept.

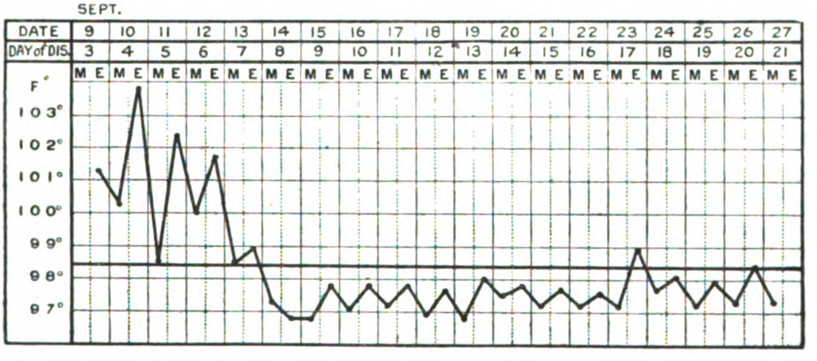


CHART 6.

It will be noticed that only a slight relapse occurred nine days after the temperature fell to normal on the eighth day.

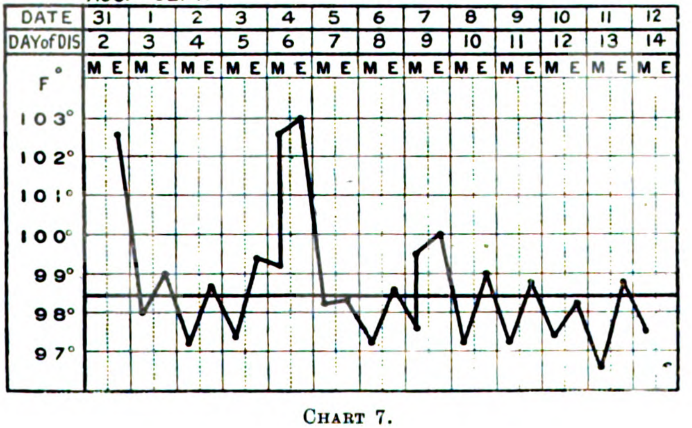


CHART 7.

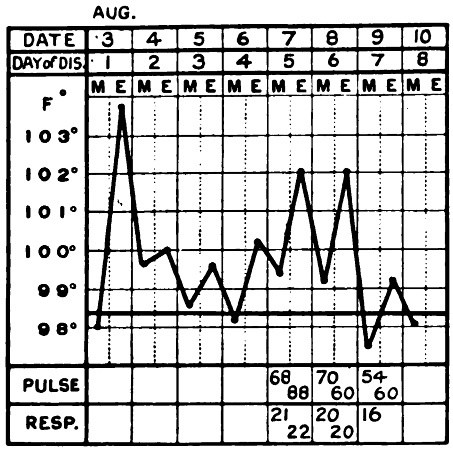


CHART 8.

Charts 7 and 8 are given as well-marked examples of the remission which may occur about the third and fourth day. Such a remission is well shown in two of the experimental cases.

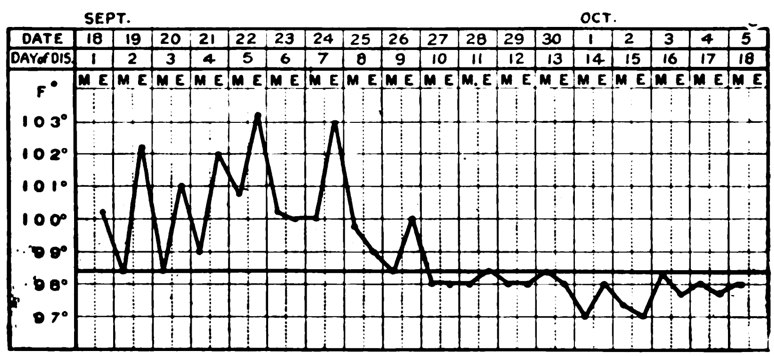


CHART 9.

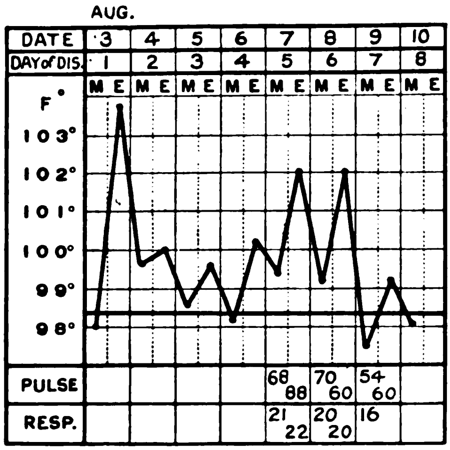
Class B.—The chief distinction between this type and the first is the number and periodicity of the relapses, so that the disease takes on the characters of a true relapsing fever. This variety is less common than the first, only about twenty characteristic cases having been observed. Apparently, however, more have been seen so far in this than in any other zone of the British front.

This type of case begins with symptoms indistinguishable from the shorter illness already described. The headache, dizziness, pain in the legs, and tendency to constipation, all are there, and

there is high fever. In short, it is at this stage impossible to foretell into which class the case will fall. A point of importance, however, is that the initial fever does not last so long as in Class A. The duration of the initial rise of temperature is naturally the most difficult part of the disease about which to obtain accurate information, most of the cases having already passed through a field ambulance before coming under our observation. In cases seen from the very beginning however (e.g., two of the personnel of a field ambulance), the duration of the initial attack was about three days, and this bears out the story of other men who only came under observation later.

After the primary rise and fall of temperature, the patient feels perfectly well, so well indeed that in several instances he has returned to his ordinary duties. Then suddenly, after a varying number of days, the man is again aware that he is unwell. Headache is, as a rule, again the initial symptom, and is often accompanied by a sensation of cold, although no actual rigor has ever been observed. Pain in the legs and small of the back return with great severity, and on taking the temperature it is found to be high, often reaching 103·8° F. As a rule the onset of the attack is sometime in the afternoon, and the height of the fever is reached the same evening. This relapse differs from that described under Class A, in the following particulars: (1) It is the first of a series of similar attacks; (2) it is sharper, the temperature is higher, and the symptoms are just as severe as in the initial attack. The duration is short, the temperature rising quickly one day to fall to normal, or almost normal, within the next thirty-six hours. Occasionally, however, the rise is not so rapid nor the fall so sudden, so that the relapse from start to finish covers a period of about three days (*vide* Chart 13). The interval between the end of the initial attack and the onset of the first relapse is most frequently about four days, and once the relapse is over the patient returns again to a period of well-being. With regard to subsequent relapses the periodicity varies, as is shown in the charts, the intervals never being exactly regular even in the individual cases.

The symptoms during the second and third relapses are, as has been already indicated for the first, of considerable severity, constant in character, and just as severe as in the first days of the disease. In subsequent relapses, however, the symptoms are not so severe, nor does the temperature rise so high. It is the headache, however, which is chiefly mitigated, the pain in the shins remaining very troublesome.



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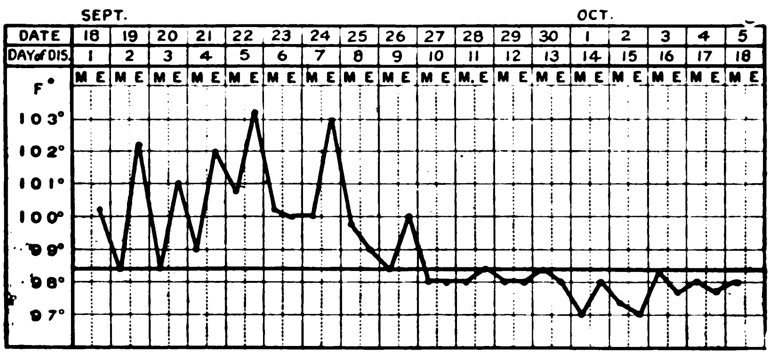

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It was interesting in these cases how often the men could accurately foretell the onset of a relapse, even before the temperature was raised. They "felt something coming on" in an indefinite sort of way, and later complained of slight headache. Thus sufficient time was often given to warn us at the laboratory that a case was relapsing, in order that various blood examinations could be made during the pyrexia.

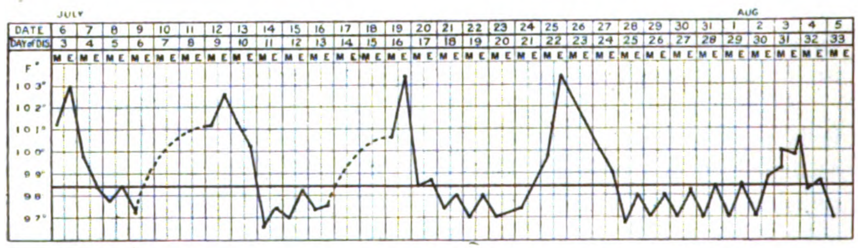

Chart 10.

The above chart is from the case of an infantry officer, and was the first case of the kind met with. Hence a great deal of attention was paid to it, and until subsequent similar charts became available the nature of the illness remained a puzzle. Many examinations of the blood were made during and just before the attacks to see if any parasite could be found, but all proved negative. In the intervals between the pyrexial periods the patient was so well that he was out of doors all day; hence the interruptions in the chart shown by the dotted lines.

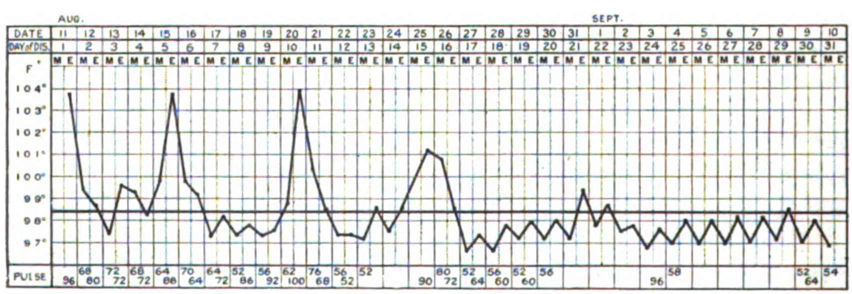

Chart 11.

This case was observed from the outset, the man affected being one of the personnel of a field ambulance. Note the short duration

of the first febrile period, the temperature being subnormal on the morning of the third day.

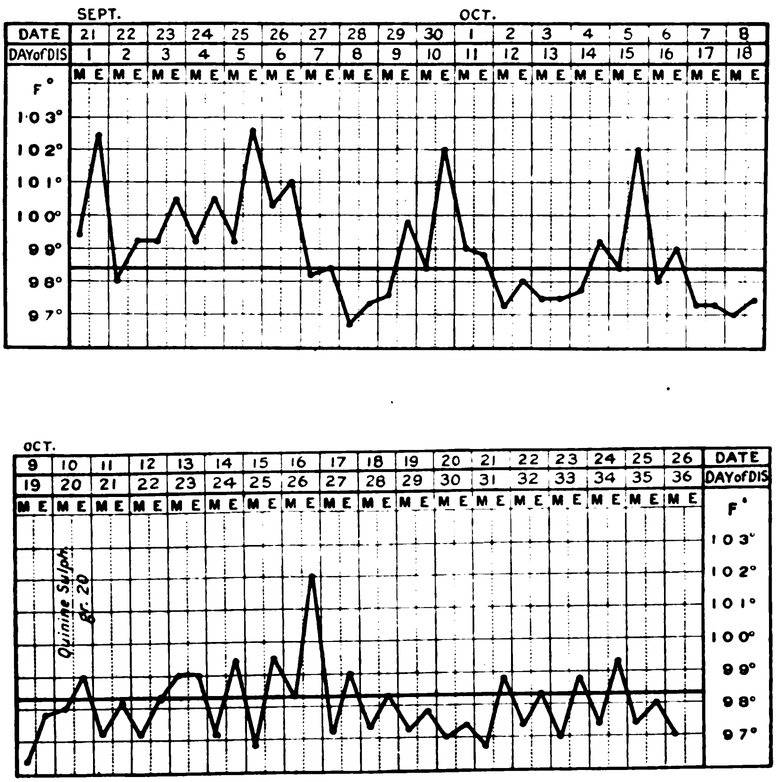

CHART 12.

This case was admitted to hospital suffering from scabies, and only fell ill after some days. The chart thus dates from the first day of the disease. On the twentieth day, when the third relapse was calculated to be due, the patient was given twenty grains of quinine. The result was interesting, as although the symptoms developed in marked degree, the temperature did not rise above 99° F.

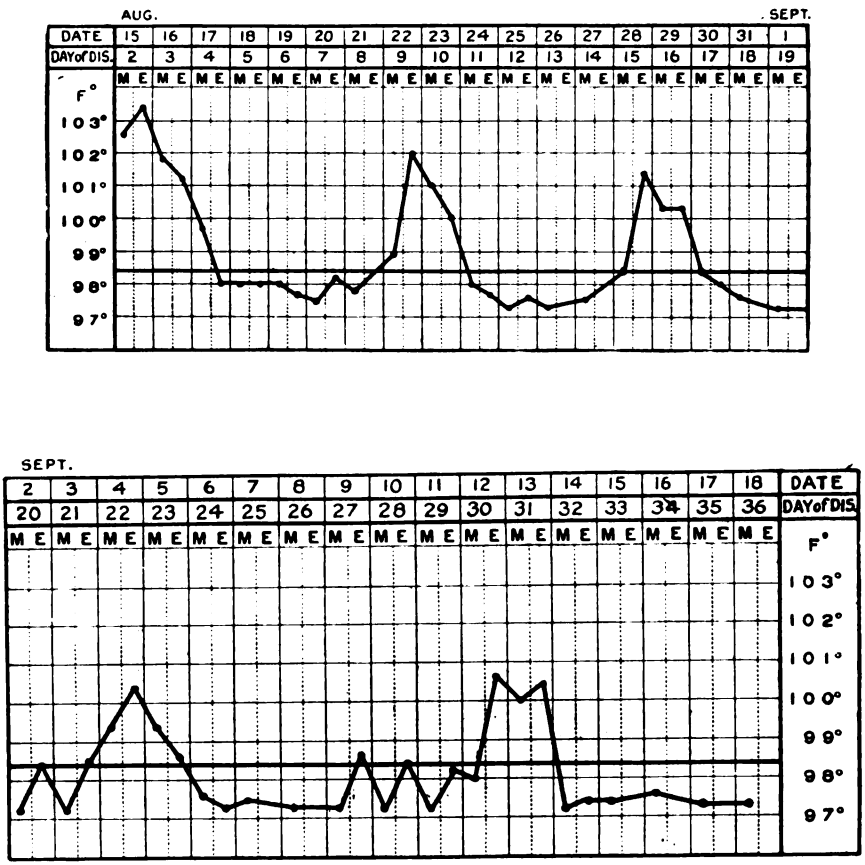

CHART 13.

This case, also an infantry officer, was admitted on the second day of illness. It will be observed that with each successive attack the temperature reached is, in every instance except the last, not quite so high as on the preceding occasion. This feature is also well shown in other charts, notably 11, 15, 16 and 17. This would thus seem to indicate progressive diminution of the infective agent, or the gradual establishment of immunity.

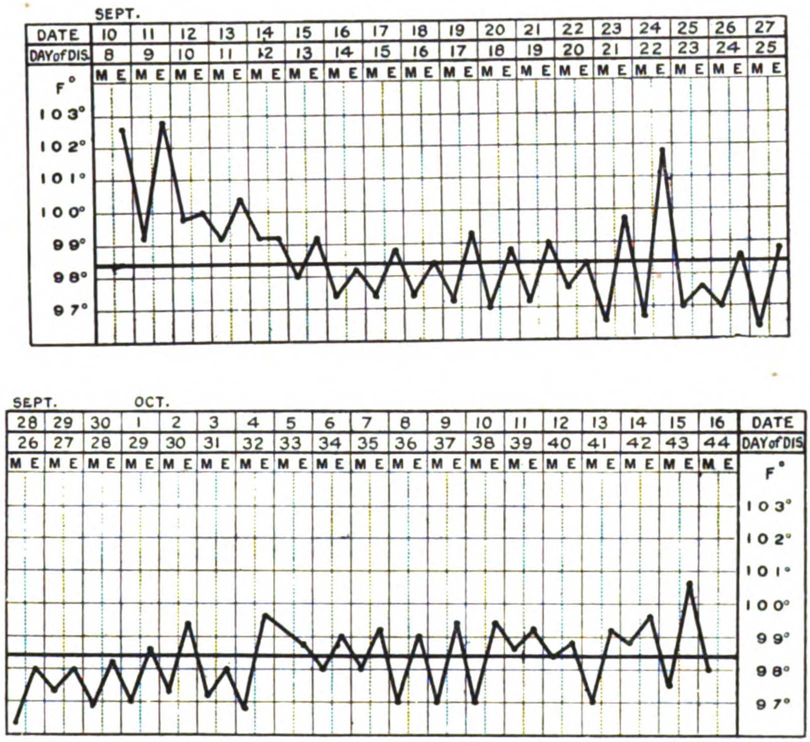

CHART 14.

This case is included as it shows a rather irregular type of chart. The man had taken ill a week prior to admission, with characteristic symptoms, and was presumably, when first seen by us, in his second period of fever.

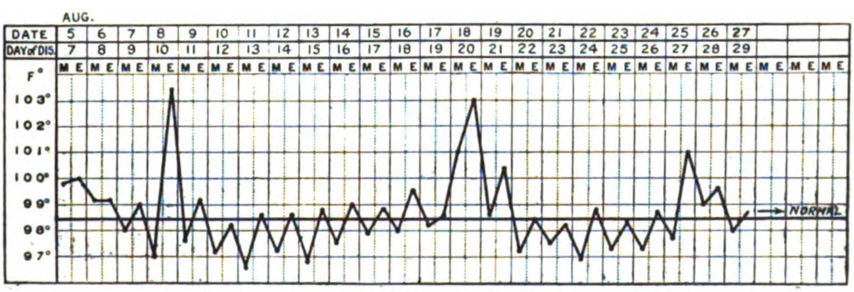

CHART 15.

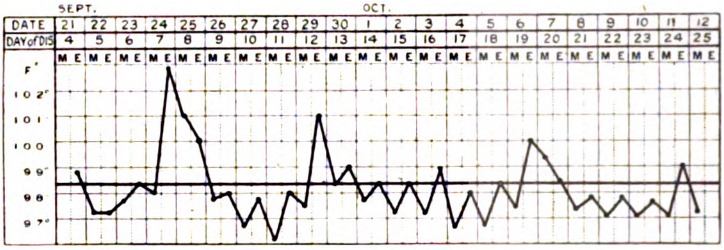

CHART 16.

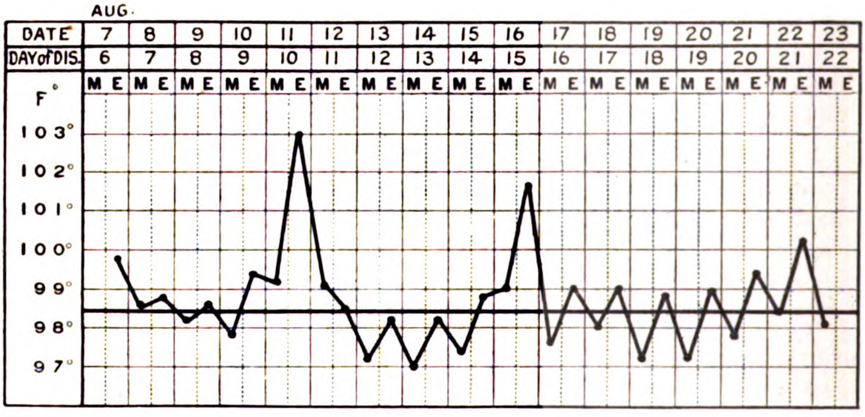

CHART 17.

Charts 15, 16 and 17 show the well-marked relapsing character of the fever. In each case the first attack had occurred before the case was admitted, the men only coming under observation on the seventh, fourth, and sixth days after the onset of the illness.

Charts 18 and 19 show types of fever different in their course from any of the others described. The clinical symptoms were, however, typical enough.

Differential Diagnosis.

The chief diseases coming under consideration in this respect appear to be :—

(1) *The Enteric Group.*—This was excluded by (*a*) the numerous negative blood cultures; (*b*) the negative examinations of stools and urine; (*c*) the negative Widal reactions in the case of paratyphoid A and B, and (*d*) the periodicity of the relapses.

(2) *Malta Fever.*—This was excluded by the negative agglutination tests.

(3) *Dengue.*—The absence of any rash seems to rule this out.

(4) *Influenza.*—The differentiation from this disease is very important, because probably the majority of the cases came into hospital with a diagnosis of influenza. It is quite certain that a

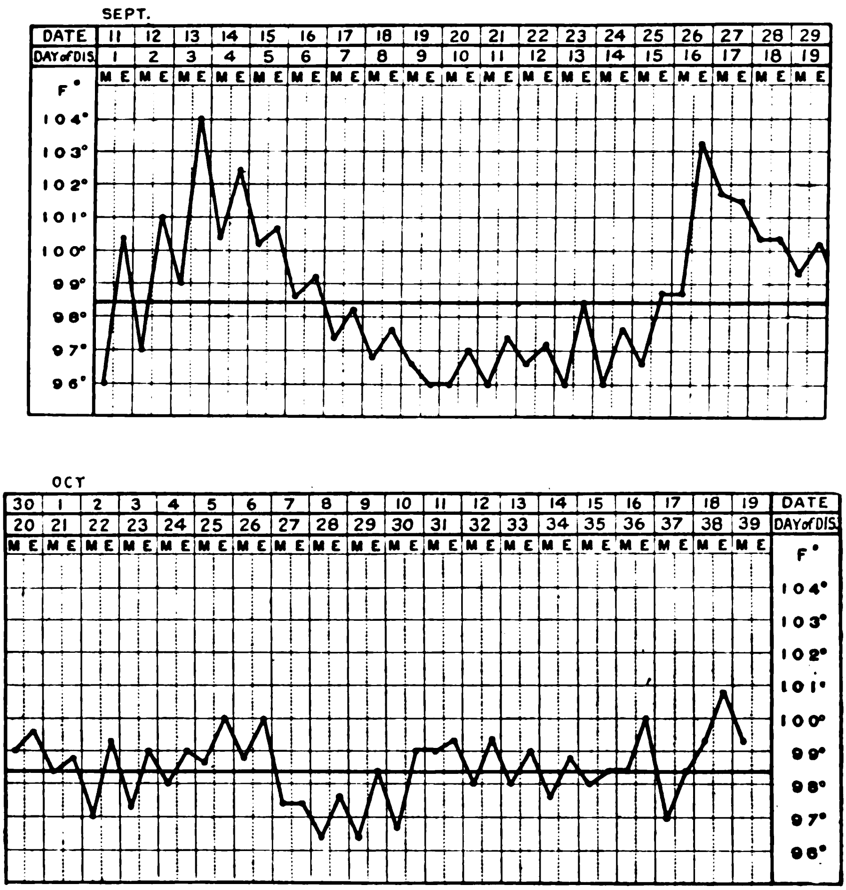

CHART 18.

great many will go down permanently into Army Records under that name. Influenza is excluded by the following points: (*a*) Absence of all catarrhal symptoms in the chest; (*b*) there is not the same prostration, cases often being found walking about with

high temperatures; (*c*) there are the periodic short relapses, the most distinctive feature of all.

(5) *Malaria.*
(6) *Relapsing Fever.* These were both excluded by the absence of any parasites in the blood films, or of any splenic enlargement.

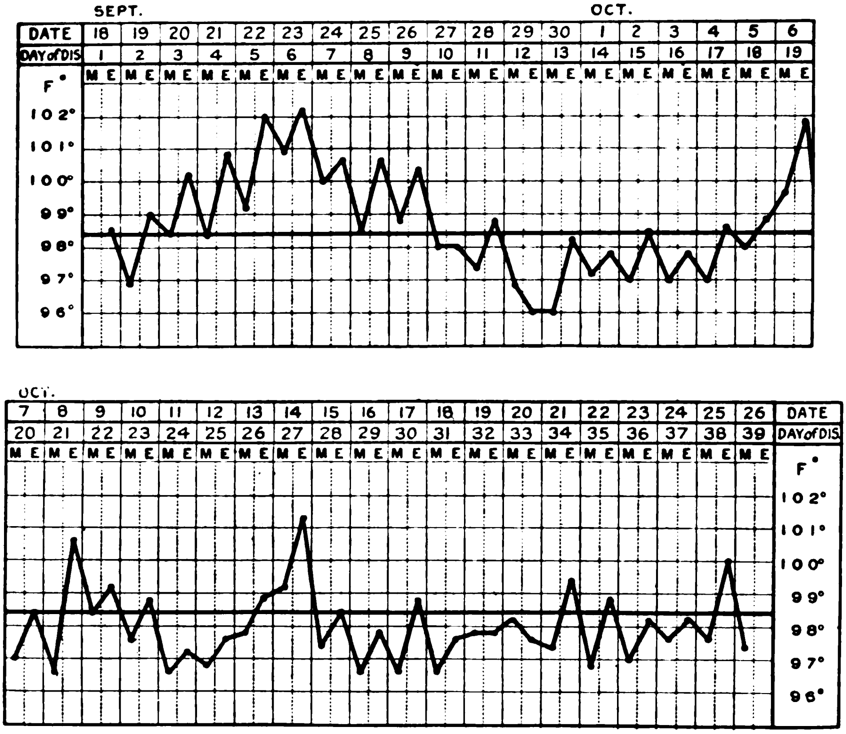

CHART 19.

Work on the Pathology of the Disease.

Work in connexion with the types of fever described has been carried on from various standpoints, and divides itself into bacteriological, pathological, and experimental. It may be said at once that the first two lines of investigation have yielded little information, but a brief account even of purely negative results must be given to complete as far as possible our knowledge of the disease. From the experimental work, on the other hand, much important information has been gained.

Blood cultures have been made in a variety of ways. At first

many of the cultures were made in the ordinary bile salt peptone broth used for the cultivation of the typhoid group of organisms. This was done because at first, as has been indicated, nearly all the cases were suspected of being enteric fever owing to the pyrexia. It is sufficient to say here that at least one hundred such blood cultures have been examined, all with negative result. All these cultures were made in the first few days of the disease, and this set of observations alone seems amply sufficient to exclude the idea first mooted that the disease might be enteric in reality, much modified by inoculation. The Widal reaction, so far as *Bacillus typhosus* was concerned, gave no assistance, owing to the high rate of inoculation. At one period a search was made for a case of this disease in an uninoculated man, but no such case on which to make agglutination tests could be found. Agglutination tests with *B. paratyphosus* A and B, and with *Micrococcus melitensis* and *para-melitensis*, were made towards the end of some cases both of long and short type, but being always found negative were not persisted with.

A considerable number of blood cultures were also made using ordinary bouillon as the culture medium, again with negative results even when the culture was left for a week or longer at 37° C. More recently anaerobic shake cultures of the blood in a large volume of glucose agar have been tried, without success.

The fæces and urine have been searched culturally in a number of cases, both during and at the end of the pyrexia, but no abnormal organisms were found.

Blood films have been thoroughly searched, both in the short and especially in the relapsing cases, for the presence of any parasite, whether intra- or extra-cellular. In a few instances the blood has been examined daily, during the fever and between the febrile attacks, but nothing resembling a parasite has so far been discovered. Various stains have been employed, but especially Leishman, Jenner, and Giemsa, films being even left in the last stain for a period of several days.

Fresh films of blood from some typical cases have been searched under dark ground illumination, but no unusual appearance was detected.

The morphological changes seen in films are of some interest. As regards the red cells, only one pathological feature occurred with any degree of frequency. This was the presence of polychromatophile cells above the normal in size; and also, especially in the relapsing cases, of well-marked punctate basophilia. In

TABLE.

Case	Date	Days ill	Hæmoglobin percentage	Red corpuscles	Leucocytes	Colour index	Polymorphs	Large lymphocytes	Small lymphocytes	Eosinophiles	Hyalines	Mast cells
J.	3.9.15	8	82*	4,470,000	10,000	0·93	58·5	8	26·5	3	4	..
M.	7.9.15	5	84	5,210,000	5,200	0·8	68	5·5	17·5	2·5	6·5	..
C.	13.9.15	6	83	5,380,000	8,800	0·73	73·5	10	10·5	2	3·5	0·5
11	—	—	—	—	—	—	67·3	22·9	4·2	0·7	4·9	..
13	6.9.15	24	83	5,390,000	7,000	0·78	64·5	7·5	16	3·5	8·5	..
21	11.9.15	2	90	5,390,000	18,200	0·84	—	—	—	—	—	—
21	18.9.15	9	83	5,560,000	6,800	0·75	71·5	6	17·5	2·5	2·5	..
21	19.9.15	10	83	5,230 000	9,800	0·79	69·5	5·6	18·4	2	3·6	0·8
21	20.9.15	11	82	5,720,000	13,800	0·72	74·4	7·2	14	1·2	2·8	0·4
21	21.9.15	12	86	5,160.000	12,800	0·84	68·6	6·6	17·3	2·6	4·6	0·3
22	9 10.15	4	84	5,200,000	7,800	0·8	53	12	28	3	3·5	0·5
24	4.10.15	3	85	5,460,000	6,400	0·81	64	12	15·5	3	5	0·5
24	5.10.15	4	—	—	—	—	63	8·5	20	4	4	0·5

* A Gower's hæmoglobinometer was used.

several cases this latter change was so well marked that very careful examinations were made to make sure the appearance was not really due to an intra-cellular parasite. An explanation of these morphological changes was found when blood counts came to be made, as all the men examined showed a definite defect in the percentage of hæmoglobin, the average colour index of a series of cases being 0·8. Although the defect in the percentage of hæmoglobin was constant, there was no loss in the number of red corpuscles, as will be seen from the Table.

The leucocytes showed no morphological changes, and differential counts only indicated a slight relative increase in lymphocytes (large and small) with a rather low figure of hyaline cells. The details are given in full in the Table.

Experimental Work.

The experimental work was undertaken to satisfy any or all of the following questions :—

(1) Is the disease transmissible by the blood (*a*) to animals, (*b*) to man?

If so :—

(2) What part of the blood is infective—the fluid or the cellular elements?

(3) Can the disease be transmitted by any or all of the following: (*a*) whole blood, (*b*) plasma, (*c*) serum, (*d*) corpuscles?

(4) If the virus is transmissible, is it a "filter-passer" or not?

(5) If ultramicroscopic, is the virus in the fluid part, or only in the cellular elements of the blood?

(6) If a virus be proved, what is the method of transmission in Nature?

Following out this scheme, experiments were first made by injecting the separated serum from marked cases into animals, rats and rabbits being used. Later, whole blood (citrated) was tried, but none of the animal experiments bore any fruit.

Thereafter, with the approval of the authorities, it was resolved to extend the experiments to men who would volunteer for inoculation. The experiments made in this way have been carried out in a Casualty Clearing Station, which by reason of its special situation has during the past summer acted as a convalescent station. Until special arrangements were made, however, no case could by rule be kept in this hospital for longer than a week, a fact which, as subsequent events proved, militated against the success

of the first experiments. The men from whom volunteers were selected were almost all cases of minor injuries (sprained ankles, etc.), i.e., men who although unfit to return to the trenches for some weeks were otherwise healthy.

The cases from which blood was taken for transmission were carefully chosen, only those in which no sign or history of past disease could be found being used. A number of typical cases were passed over at the time for this reason.

The experiments were begun on August 11, 1915, when five cubic centimetres of blood were taken from each of two typical cases, and transferred immediately into the veins of two other men. Nothing occurred during the week these men remained under observation, and the men were then evacuated to the base and lost sight of. Positive results began to be obtained whenever permission was received to keep the cases, and the men inoculated from them, for a longer time under observation.

An account will now be given in detail of the first case in which the transmission was accomplished.

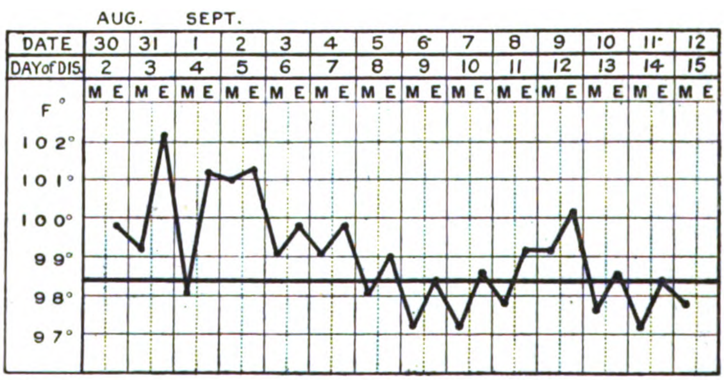

Chart 20.

On September 2 a Royal Army Medical Corps orderly, Pte. S., who had been on duty in the ward in which the "trench fever" cases were being kept, was in the middle of a brisk and typical attack of the disease. His temperature chart is given above. (Chart 20.)

At a time when his temperature was 101·4° F. five cubic centimetres of his blood were taken into a syringe previously washed out with citrate solution, and transferred immediately into the veins of Pte. W. Pte. W. remained well until September 11,

nine days after the inoculation. On the evenings of the third and fourth days his temperature reached 99° F., but he felt perfectly well at the time.

On the morning of September 11 he awoke at daybreak feeling unwell. He had a slight headache, and his temperature on being taken at 6.45 a.m. was 99·2° F. He got up, but could not remain out of bed for longer than an hour, as the headache became more and more severe, and he felt cold and "shivery." He returned to bed at

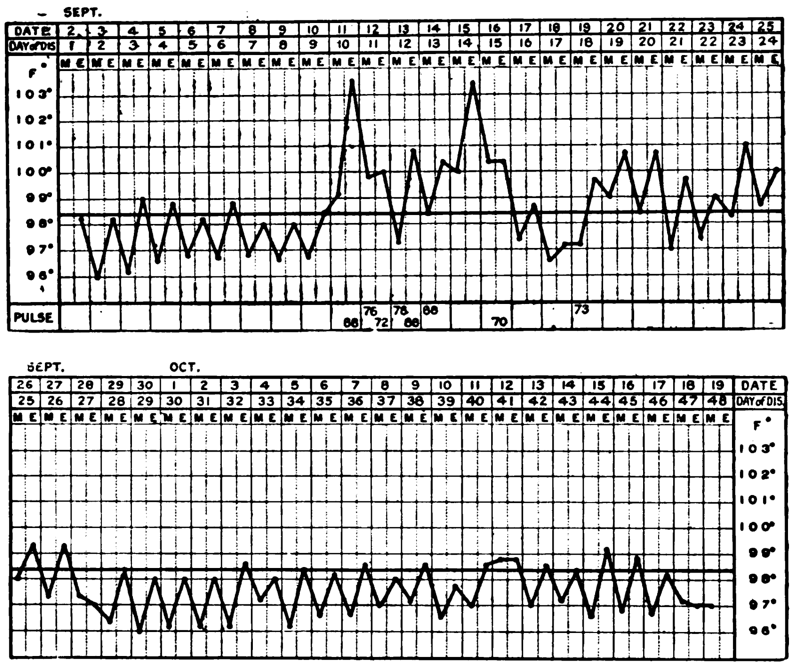

CHART 21.

9 a.m., and soon after was attacked by pain, chiefly in the thighs and small of the back. Unlike other cases, he had no pain below the knees. By evening he felt very ill, and at 6.30 p.m. his temperature was 103·8° F., and pulse 88. Next morning he was rather better, the pain being easier, although the headache remained severe. His temperature, too, had fallen, being 99·8° F. in the morning and 100° F. at night. On the third morning his temperature was normal, but the headache remained, and the pain did not entirely pass off. The same evening, however, he was

perspiring profusely, and felt just as ill as on the first day of the attack. His temperature on this occasion was 100·8° F. The following morning there was again a slight remission, but only for a short time, and during the next few days he was very ill until the temperature reached normal once more on the seventh day after the onset. The complete chart is given. (Chart 21.)

Immediately the temperature became normal he felt comparatively well, and was able to sit up for a short time. His headache was completely relieved, but he still had slight pain in the thighs. Thereafter two definite relapses occurred, the one reaching its acme on September 19, and the other on September 23. During these relapses, headache and pain in the thighs and back returned with considerable severity, without being, however, quite so severe as at the beginning. It will be observed from the chart that one relapse was at its height about four days after the temperature fell to normal on the seventh day, and that the other followed at a precisely similar interval.

Various symptoms, etc., of lesser bearing have been purposely omitted in the account of this case, so as to bring those of importance into prominence. It is sufficient merely to mention that anorexia and a definite tendency to constipation, both symptoms common to many febrile diseases, were present to a considerable degree.

The subsequent course of the case was towards complete recovery, but it is a noteworthy fact that whenever the temperature rose in the least degree above normal (as for example on October 15, thirty-five days after initial fever), the pain in the thighs returned with severity. This has been observed in other cases, the patients being able to tell that their temperature was a little high by the return of the pain.

Fairly numerous blood examinations made on Pte. W. during his illness are shown in the table already given.

It was resolved to try to carry on Pte. S.'s infection through Pte. W. to a third generation, but no opportunity for doing so occurred until September 19, nine days after the beginning of Pte. W.'s attack. On this day ten cubic centimetres of blood were taken from Pte. W. into a syringe previously washed out with citrate solution and injected intravenously at once into Pte. D.

This man kept well until September 24, five days after the inoculation, when a typical attack of the disease was again reproduced. (Chart 22.)

He took ill in the evening, feeling "shivery" and out of sorts.

His temperature was found to be 99·8° F., and during the night intense headache and pain in the thighs developed. Next morning when seen he was very ill, complaining especially of pain behind the knee-joints, and at noon his temperature stood at 102·4° F. The following day his temperature was normal, and all the symptoms practically abated, so that he wished to get up. Thereafter, although a slight rise of temperature occurred on three successive evenings, he kept perfectly well until October 4. During this interval of ten days he was able to go out of doors every day, and felt quite in his usual health. A relapse then occurred, all the original symptoms returning with even more severity than in the first attack. His temperature reached 103° F. on the 5th, and then fell, all symptoms and fever having passed off by October 7. A period of well-being again followed, lasting until October 15,

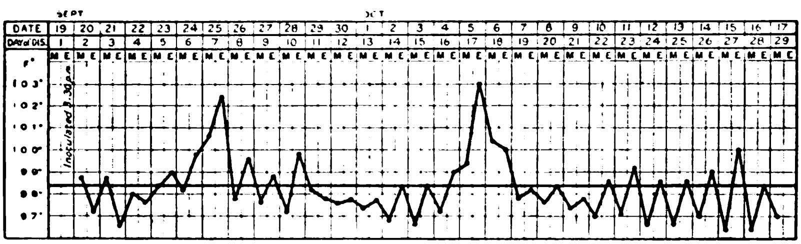

CHART 22.

when a further relapse developed with the usual set of symptoms. These were not severe, the temperature only rising to 100° F., and next day the patient was better again.

It is important to observe that the highest temperatures recorded in the three attacks occurred on the seventh, seventeenth, and twenty-seventh days after the inoculation, i.e., the interval between the height of each illness was exactly ten days. The periodicity in this case has, we also consider, a further importance in helping to establish the unity of the "short" and "long" types of disease described in the earlier part of this paper. The first case, Pte. S., represents in our original description a fairly typical "short" type. The second, Pte. W., seems merging into the other or "long" type, and the third, Pte. D., if the case had occurred naturally, would have been put without hesitation into the latter group. The results of the experiments just described, taken along with the identity of the clinical symptoms in every case, seem to constitute very strong links in the chain of evidence

supporting the view that all are simply varieties of one and the same disease.

The next experiment to be referred to had its origin also in an R.A.M.C. orderly, who had also been in contact with a number of cases. This man, Pte. C., took ill on September 15, with the, by this time, well-recognized symptoms. His chart is appended, and shows a fairly typical curve. (Chart 23.)

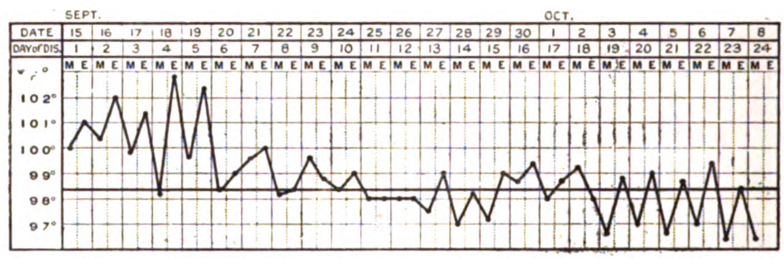

Chart 23.

On September 19, when his temperature was 102·4° F., five cubic centimetres of blood were transferred immediately into the veins of Sapper M. This man kept well until October 2, thirteen days after the inoculation, when he suddenly felt dizzy, cold, and shivery, while going down the long hospital stairs. He had no headache until the evening, when his temperature had risen to 102·6° F. (See Chart 24.)

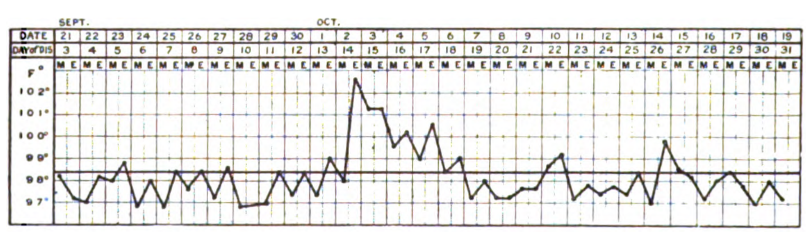

Chart 24.

Pain in the legs had come on previously (at 4 p.m.), and was at first worst round the hips. During the night the pain became more localized to the back of the knees and to both ankles, and felt, so he said, deep down to the bones. The symptoms continued until October 7 without remission, when they passed off quickly. A relapse occurred on October 10, four days after the end of the first pyrexial period, and a second on October 13, after a similar

interval of four days. On neither occasion were the symptoms severe, the temperatures only reaching 99·2° F. and 99·8° F. respectively.

Having shown in these three men, Pte. W., Pte. D., and Sapper M., that the disease in typical form could be transmitted from cases by immediate inoculation with "whole blood," it remained to continue work on the scheme outlined at the beginning of this section.

Serum experiments had been begun early, as the blood from typical and suitable cases could be collected at different field ambulances, the serum separated in the laboratory, and thereafter injected into volunteers when available. The first experiment with the blood serum, made on August 20, was a failure, but the two men were only under observation for about a week. The serum was, in this experiment, passed through a Doulton filter candle without dilution, before being injected. On August 22 the pooled serum from four typical cases was, after the addition of an equal bulk of saline, passed through a Doulton filter, and injected into two men. Nothing happened, although the men were kept for a fair time under observation. This attempt to prove whether the virus was a "filter-passer," before the infectivity of the unfiltered serum was tried, seems to indicate rather a cart-before-the-horse procedure, but it was adopted at the time for the following reasons: It was thought from analogy in the first place that the virus might be somewhat of the same nature as those of yellow fever or sand-fly fever, etc.; and also, the blood being at the time collected, often under difficult conditions, from field ambulances, the sterility of some of the samples might be in question. We felt safe, however, in injecting the sera after they had passed through the porcelain filter candle.

Two other men were again on August 25 inoculated with the pooled serum of three typical cases, the serum being previously filtered through a Doulton candle. A negative result was obtained. The same type of experiment was carried out on August 27, the pooled serum of four typical cases being filtered as before. A negative result was again obtained. It was then suggested to us by Sir William Leishman that our failure to get the virus through the filter was possibly due to the serum not being sufficiently diluted with saline, in none of the experiments so far described more than an equal volume of saline having been employed. In our subsequent experiments therefore, the serum was always diluted with ten volumes of saline.

These experiments now to be detailed were conducted under

the best conditions in the casualty clearing station where so much of the work has been done, and were designed to satisfy several questions at once. They must therefore be described as separate experiences, leaving the conclusions to be drawn at the end.

On October 7, blood was withdrawn from Pte. B., on the day before his fifth attack of fever, and in the fourth week of his illness. Five cubic centimetres of blood were taken into a syringe washed with citrate solution, and injected at once into Pte. Dm. The remainder was allowed to clot, the serum separated, and divided into two parts each of three cubic centimetres. One of these parts was diluted with ten volumes of saline and rapidly filtered through a Berkefeld "V" filter. Thereafter the three cubic centimetres unfiltered serum were injected into Pte. T., and the filtered and diluted serum (now thirty cubic centimetres of fluid) was transferred intravenously to Pte. M. These two injections were made about four hours after the blood was withdrawn.

The chart of Pte. B. (Chart 25), from whom the blood was withdrawn, is given below. When admitted he gave a history of two previous attacks of fever, and four relapses, shown on Chart 25, occurred in hospital.

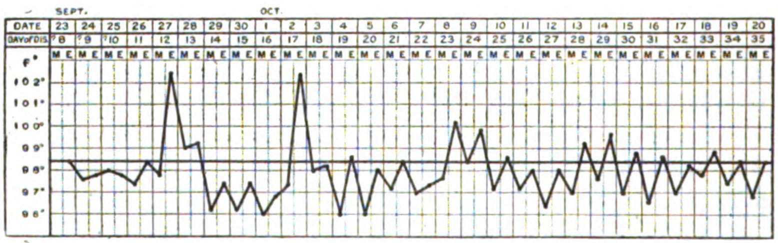

CHART 25.

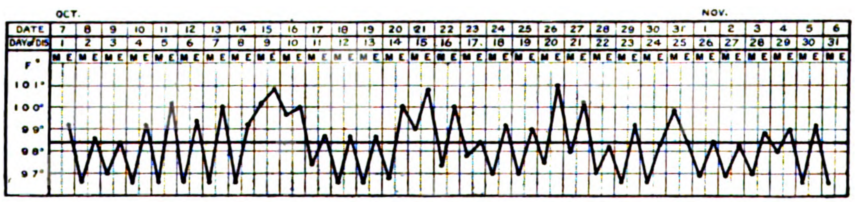

CHART 26.

Pte. Dm. (Chart 26), into whose veins the "whole blood" was injected, began at once to run an irregular temperature, but without obvious symptoms, until the evening of the eighth day. Then the

usual symptoms of headache, pains in the back and legs, etc., appeared, and continued until the temperature fell to normal three days later. Thereafter three relapses occurred, each reaching its acme, as shown by the highest temperature recorded, five days after the previous one.

Pte T. and Pte M., who received respectively serum and serum after dilution and passage through a filter, kept perfectly well for four weeks under observation, their temperature charts not showing any deviation from the normal.

In this experiment, therefore, only the "whole blood" was infective, no result being obtained with serum, filtered and unfiltered.

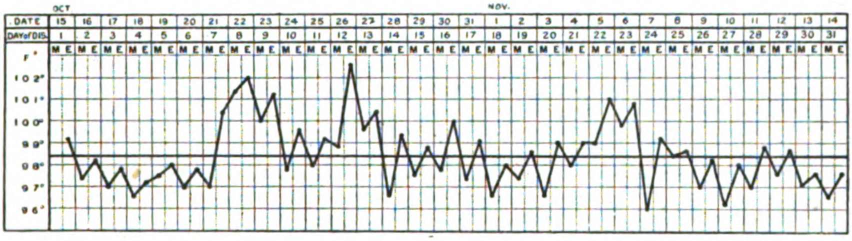

CHART 27.

The next experiment had as its basis the case of Pte Dm. (Chart 26) just described, whose attack followed the injection of the blood of Pte. B. The blood was withdrawn on October 15, when the temperature was 100·8° F., and the symptoms well marked. Pte. Wx. was injected at once with 5 cubic centimetres of blood, taken into a syringe washed with citrate solution. The remainder of the blood was taken to the laboratory in two parts, one being citrated to prevent clotting, and the other being allowed to coagulate. The citrated blood was centrifugalized at once, 8·5 cubic centimetres of plasma being thus obtained. The other part of the blood yielded after coagulation 10 cubic centimetres of serum. This was divided into two, 5 cubic centimetres being set aside, while the other portion was diluted with ten volumes of saline, and filtered as before through a Berkefeld "V" candle. The total bulk of the diluted fluid was thus 50 cubic centimetres. It must be pointed out here that when ready for injection, owing evidently to some fault in technique, both the plasma and the serum were somewhat hæmoglobin tinted, i.e., some red corpuscles had been damaged and the hæmoglobin liberated. The importance of drawing attention

to this will be realized when the results of the experiment are noted. Pte. Wx. (Chart 27), into whom the "whole blood" was transferred, developed, as is shown in the chart, an extremely typical attack, with the usual relapse and the customary symptoms. The incubation period was in his case seven days.

In the case of Pte. O. (Chart 28), into whom 8·5 cubic centimetres of plasma were injected, a quite characteristic positive result was obtained after a period of thirteen days, as is shown in the chart.

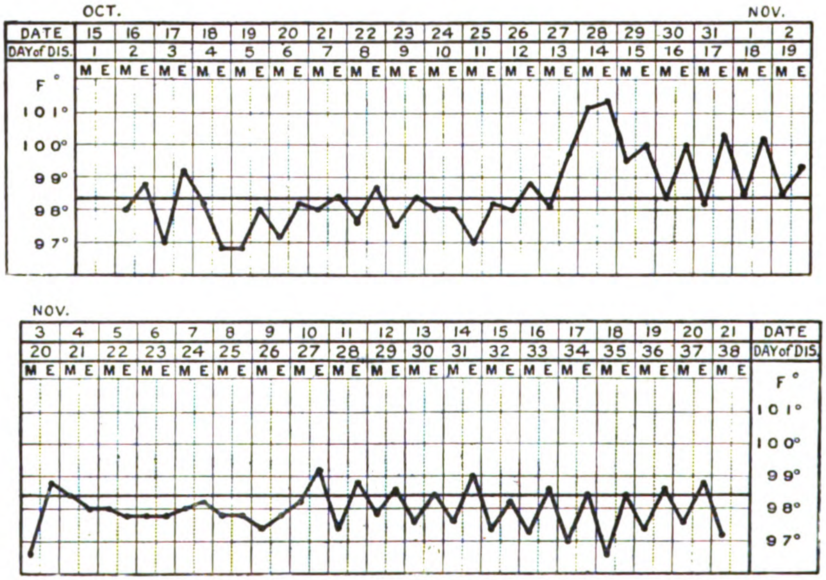

CHART 28.

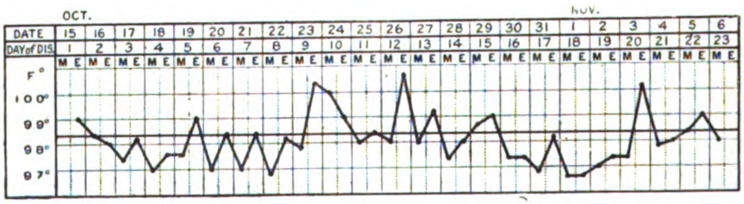

CHART 29.

A positive inoculation also resulted on the ninth day after the introduction of 5 cubic centimetres of serum into the veins of Pte. N. (Chart 29), whose chart is also given.

Clinically, the illness caused by the introduction of the "whole

blood" was much more severe than that brought about by inoculation with either serum or filtered serum—a fact well shown by comparing the three temperature charts.

The man Pte. R., into whom the filtered serum was introduced, remained absolutely without symptoms, even when watched carefully for over a month, and his temperature taken night and morning.

As it was felt that this last experiment made with plasma and serum was not perfect owing to the hæmolysis which occurred in preparing the specimens for injection, it was resolved to repeat the test.

On October 21 Pte. P., an Army Service Corps driver attached to the casualty clearing station, where our experiments were carried out, was in the second day of what clinically was a typical attack. The complete chart of this man (Chart 30) shows an unusually long initial period of pyrexia, but the clinical symptoms (headache, severe pain in the shins, etc.) and the subsequent relapses were characteristic enough.

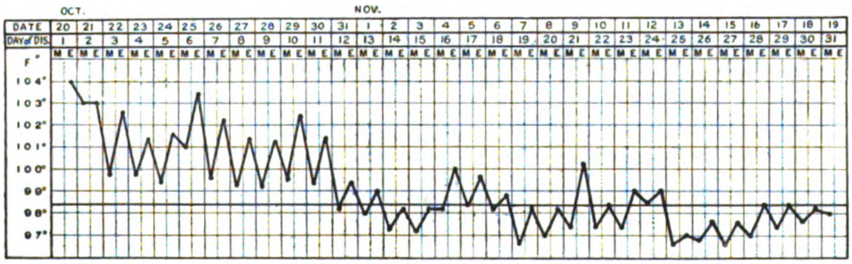

CHART 30.

On this day (October 21) a quantity of Private P.'s blood was taken into citrate solution. Five cubic centimetres of the citrated blood were injected at once *intramuscularly* into Pte. A. The remainder of the citrated blood was dealt with as follows: The blood was centrifugalized and the plasma removed. Thereafter the corpuscles were washed thoroughly six times with normal saline solution to completely free them from traces of plasma. The washed corpuscles corresponding to 5 cubic centimetres of blood were then taken, suspended in sufficient saline to make up to 5 cubic centimetres, and injected intramuscularly into Lance-Cpl. B. The remaining washed corpuscles (equivalent also to about 5 cubic centimetres of blood) were mixed in a bottle with fine sand

and glass beads, and shaken thoroughly so as to break up the corpuscles as far as possible. The mixture was then extracted with saline, and the bright red hæmoglobin-tinted fluid passed through a Berkefeld "V" filter. The filtrate (16 cubic centimetres in bulk) was injected intramuscularly in to Gnr. S. This last part of the experiment, in which an attempt was made to break up as much as possible the corpuscular elements, was undertaken to see if possibly (a thing hitherto unheard of) the virus might be ultramicroscopic, and a filter-passer confined to the cellular elements of the blood.

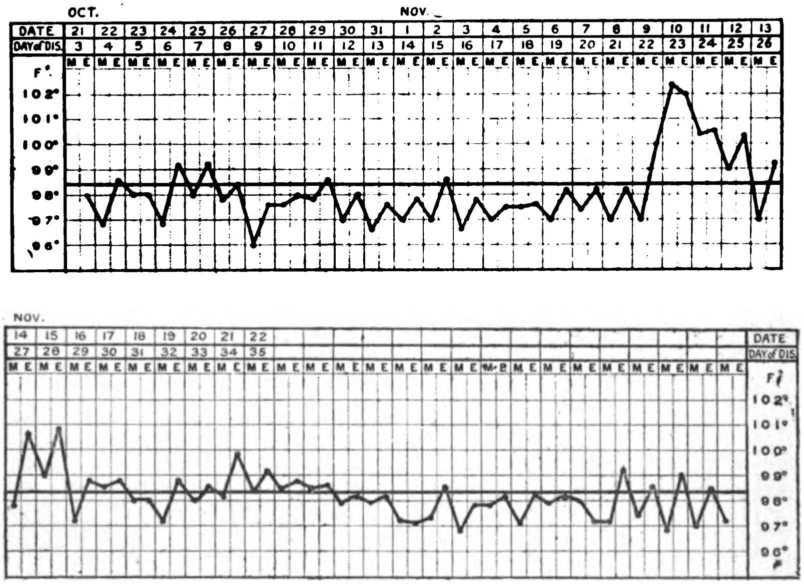

CHART 31.

Of the three men injected in this experiment only one developed the disease, namely, Pte. A., into whom the citrated whole blood was injected intramuscularly. The incubation period was twenty-one days, and the attack, which was typical, is shown on the accompanying chart (Chart 31).

The other two men were watched for over a month, and they remained perfectly well.

The only positive result obtained from this experiment was, therefore, the fact that citrated whole blood is infective when inoculated intramuscularly as well as intravenously.

The last experiment of our series had, as its basis, Pte. A.

(Chart 31), who had been infected with the citrated whole blood of Pte. P., injected intramuscularly. On November 10, when Pte. A. was in his first day of illness, and his temperature 102° F., some of his blood was withdrawn into sterile citrate solution. All of the citrated blood was taken back to the laboratory for the following reason. It will have been observed that in all the previous experiments, the citrated whole blood was injected at once, whereas the remainder of the blood had to be taken to the laboratory for preparation. Thus two or three hours generally elapsed before the remaining injections could be made. It was resolved on this occasion to make all the inoculations at the same time, so as to exclude the possibility of the virus dying out in the intervening two or three hours. All the injections in this experiment were thus made at the same time, about three and a half hours after the blood was obtained.

In this, our last experiment, the following tests were made, all the inoculations being intramuscular:—

(1) Citrated whole blood, both as a control and for the reason referred to in the preceding paragraph.

(2) Corpuscles freed from plasma by washing with saline.

(3) Plasma, filtered through a Berkefeld filter candle.

(4) The filtered product of broken-up corpuscles previously washed with saline.

The technique of the preparation for the last three parts of the experiment must be briefly recounted. The plasma was obtained readily enough by prolonged centrifugalization, and was quite clear and free from hæmolysis. After separating the plasma, the corpuscles corresponding to 5 cubic centimetres of blood were taken, and washed five times in saline. The corpuscles were always thoroughly mixed with the saline before centrifuging, and 10 cubic centimetres of normal saline were used for each washing. After the final washing the corpuscles were made up to 10 cubic centimetres with saline before injection.

For the remaining part of the experiment the corpuscles corresponding to about 10 cubic centimetres of blood were obtained by the centrifuge, and washed as before five times with normal saline. The solid corpuscles were then mixed with fine sand and pounded up thoroughly in a mortar. The mixture was extracted with saline, and the product filtered through a Berkefeld "V" filter as usual, the result being 22 cubic centimetres of a clear deep crimson fluid. The results of the inoculations in this experiment may now be given:—

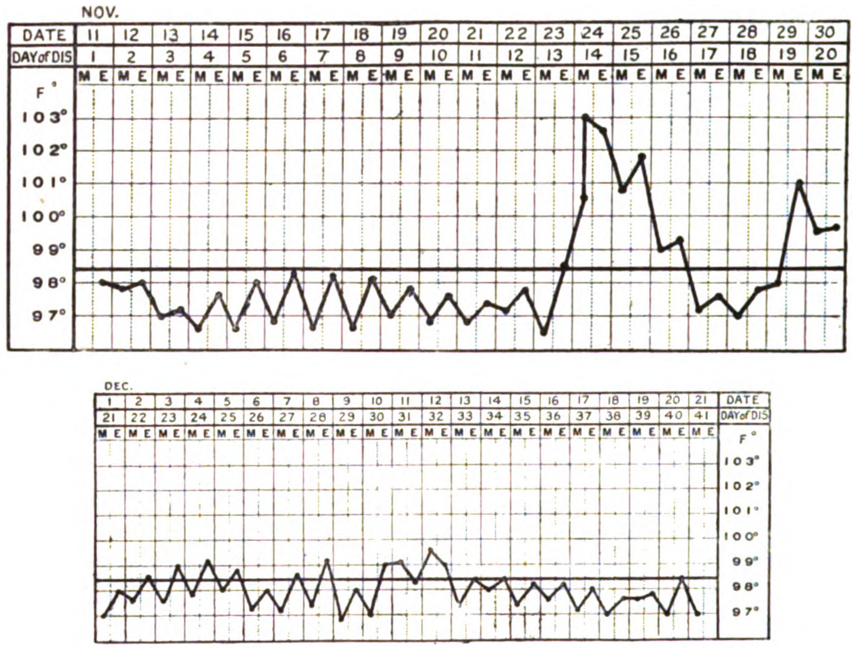

CHART 32.

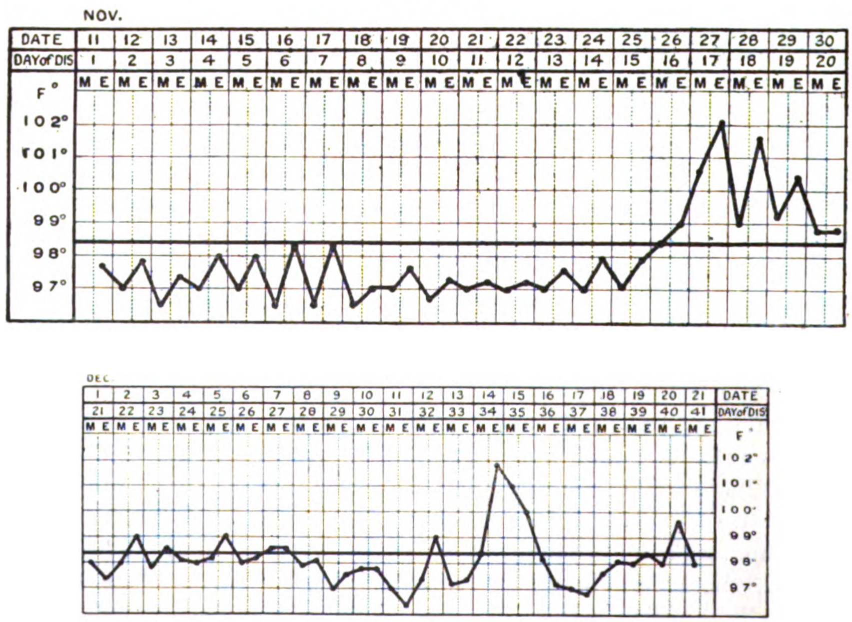

CHART 33.

Pte. R., into whom the citrated whole blood was injected, took ill thirteen days after inoculation, and his chart is now given (Chart 32).

Pte. Pd., into whom the washed corpuscles of 5 cubic centimetres of blood were injected took ill with the usual symptoms sixteen days after inoculation. His chart is also shown (Chart 33).

Neither of the other two men into whom, respectively, 4·5 cubic centimetres of plasma after passage through a Berkefeld filter, and 22 cubic centimetres of hæmoglobin-tinted fluid (obtained by breaking up corpuscles and filtering as described), were injected, fell ill in any way during the full month they were observed.

All the men who were voluntarily inoculated with the disease have returned to normal health. Communication has been maintained with some of them and the only complaint has been a slight return of pain in the legs when fatigued, in a few cases.

Other experiments throwing some further light on the illness could have been attempted, but it had always to be remembered that soldiers were the subjects of the tests. An important point to settle, for instance, would have been the question of whether one attack of the disease conferred immunity or not, against a second inoculation.

Summary and Conclusions.

(1) The disease is a definite entity, and of infective nature, as is proved by its ready transmission from one person to another by the blood.

(2) There are two clinical types of the disease: (*a*) A short fever of about a week's duration, followed frequently after a few days by a single short relapse; (*b*) a longer illness characterized above all by the number, sharpness, and periodicity of the relapses.

(3) The symptoms of both types are clinically identical, the most constant and characteristic being headache and pain in the legs and small of the back.

(4) The two types described are, in our opinion, merely varieties of one and the same disease. In addition to the identity of symptoms, the experimental evidence for this is strong, a typical "short" variety having been shown capable of giving rise to a typical "long" one.

(5) The incubation period varies, possibly with the dose of the infective virus introduced. The shortest incubation period in our experimental transmissions was six days, and the longest twenty-two days.

(6) The disease is transmissible in every case by the whole blood, whether injected intravenously or intramuscularly.

(7) The disease is not transmissible by the serum. In the one instance in which the serum proved infective, hæmolysis of corpuscles had occurred before injection.

(8) It follows as a corollary to the preceding statement that virus is not a "filter-passer" in the serum, as we thought from analogy that it might be. All our experiments with filtered serum were negative.

(9) The plasma was infective in one experiment, but hæmolysis of red cells had occurred so that the plasma was hæmoglobin-tinted. The filtered plasma in another test was not infective.

(10) The above results seemed to point to the virus being contained *within the blood corpuscles themselves*, whether leucocytes or red cells.

(11) Blood corpuscles, after washing five times in saline to remove the plasma, were still found to be infective. This further supports our view that the virus is intracorpuscular.

(12) Very many blood films at all stages of the disease have been examined, without a parasite being detected. The blood has been examined fresh, under dark ground illumination, and dried films have been stained in varying ways, without result.

(13) Blood corpuscles were broken down, and the hæmoglobin-tinted fluid passed through a filter in an attempt to prove the virus an ultramicroscopic one confined to the corpuscles. The fluid when injected, however, was not found to be infective.

(14) The only constant morphological change in the blood is the presence of punctate basophilia. This was so marked in some cases as to require very careful investigation to differentiate it from an intracellular parasite. The blood counts, differential and ordinary, did not yield any important results.

(15) As regards the means by which the disease is transmitted in nature, we have as yet no evidence to offer. The fact that only two classes of men are affected—those from the trench zone and men of the Royal Army Medical Corps—is, however, suggestive. The disease is either contagious from man to man, or, what seems much more likely, is carried by one of the common flies or parasites found in the trenches. During the past summer lice, mosquitoes, midges, and flies of other kinds, have all been common in the Flanders war zone.

We wish to express our thanks to all the officers of the Royal Army Medical Corps, who have helped us so much in this investigation, and especially to Surg.-General Porter, Col. Sir William Leishman, Col. Sir Wilmot Herringham, Lieut.-Col. W. P. Peake, Capt. G. W. M. Andrew, and Capt. Vick.

NEURASTHENIA: WHAT IT COSTS THE STATE.

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It is always exceedingly difficult after an injury to determine how much of the alleged disability is due to a physical condition consequent upon the injury, how much to true neurosis, and how much to wilful exaggeration.

Functional nerve disease is a disorder of the mind rather than the body. The difficulty is to determine how much of a condition is the effect of trauma and shock, and how much is due to a faulty nervous system or a perverted mental outlook. To act fairly in a case of this sort both to the State and the soldier is a task which can best be performed by those who are constantly in touch, not only with functional nerve disease, but also with the nature of the soldier's work in civil life to which, if superannuated, he has to return.

When confronted with these difficult cases the first and all-important step to take is to make as absolutely certain as one possibly can *that there is no organic disease present.* This is by no means easy, as the symptoms of certain organic diseases in their incipient stages closely resemble neurasthenia, or they may, as in the following case, be feigned :—

A. A. had done no work for six and a half years; an insurance company paid him during that time and he had been examined by several medical men. His only complaint was giddiness; when he entered my consulting room he staggered and swayed in a suspicious manner. He was sharply called to order and the swaying altered. When asked to run up the stairs in my hall he did so, but on coming down he deliberately stumbled, taking care not to injure himself. He was therefore told to go up to the top of the stairs and come down again without holding on to anything. This he did. When asked to stand with his heels and toes together he showed no evidence of Romberg's sign but deliberately fell backwards. I let him clearly understand that I saw that what he was doing was a pretence, and told him very firmly that he was not to do it. On repeating the experiment he boldly let himself fall straight back, and lost his equilibrium and would have fallen on his back had not a medical friend, who the claimant knew was behind him, caught him under the armpits. My friend, recognizing what was happening, said, "I

shall leave the room," and, opening the door behind the patient closed it again, pretending that he had left the room, and remained motionless behind the man. I repeated the experiment. This time the claimant went backwards, but fell in a sitting position—that is to say, he let himself down gently, thinking that there was no one to catch him!

Neurasthenia is a disease of which the cause is stress in one of two forms, namely, sudden injury to body or mind, i.e., shock, or chronic injury to the mind in the form of worry or anxiety.

In the traumatic form of neurasthenia the stress is always of the sudden kind in the first instance, which may *in itself* be insignificant, but is often followed by chronic anxiety or worry.

Although neurasthenia is essentially a mental state, it generally has some bodily disorder associated with and underlying it.

The immediate causation may be purely psychic, or purely physical, i.e., traumatic; more often it is partly psychic and partly traumatic, and the share of these two factors varies greatly in different cases and under varying circumstances.

As an instance of purely psychic origin, an engine driver who *saw* an apparently inevitable accident before him, suffered from a bad attack of neurasthenia, even though the accident at the last moment was averted.

In diagnosing traumatic neurasthenia, a valuable asset is the doctor's knowledge of human nature and his experience of similar cases.

A traumatic neurosis depends not so much upon a physical injury as upon an exaggerated *idea* of the injury.

The extreme importance of appreciating the influence the mind has upon the body, both in the interests of the soldier and it may be of the State, is illustrated by the following case, which was that of a young man who was submitted to me for examination after being ill for three weeks:—

A. B.'s temperature appeared to range between 97·4° and 103·4° When his doctor took the temperature in the morning it was always normal or subnormal; the patient himself took it sometimes as often as six times in the day, waking occasionally in the middle of the night for this purpose. There was no evidence of disease beyond the raised temperature. As a last resort his blood was tested for typhoid fever with a negative result.

I discovered that if the doctor did not call once daily he was always sent for in a hurry, and that the patient was obviously very nervous and worried. His wife was hourly expecting her baby.

I induced the doctor to take away his thermometer from A. B., when the afternoon temperatures, which previously had, as a rule, been above normal, were found to be normal. Indeed, from the time that the thermometer was taken away from him the patient made a rapid and uninterrupted recovery.

The true explanation was that the poor fellow had only one bed in the house, his wife was daily expecting to be confined, and he was feverishly anxious to recover in time.

Even in the lower animals the influence of mind on body is seen in what is known as psychological secretion. When a dog smells the preparation of meat for his dinner he secretes one kind of saliva, but when he smells a meal of biscuit or bread the secretion appears to be of a different character.

Jerome K. Jerome makes one of his characters say, after studying a considerable amount of medical literature, that he believed the only disease he had not suffered from was housemaid's knee. This is only a humorous exaggeration of a profound truth.

The objective *signs* of bodily disease, when present, can be easily discovered, but *symptoms*, whether of body or mind, are purely subjective, and great difficulty often arises, not so much in discovering these, as in appreciating their relative value and reliability. It is, in truth, never easy to form an opinion as to how much of a patient's complaint is due to a substratum of bodily defect, and how much is coloured by concurrent mental disorder.

To form an opinion as to how far a patient's symptoms are attributable to his faulty mental processes, it is important to bear in mind the two chief forms of functional nervous disease—neurasthenia, more especially traumatic neurasthenia, and hysteria—and to distinguish these from malingering. Judging from the number of cases submitted to me which have previously been seen by many medical men, there is reason to fear that these diseases are imperfectly understood and not always dealt with firmly.

A. C. had an accident and was said to have injured his back. He complained of persistent pain in his back, which he kept bent when out of doors. He walked with an awkward, shuffling gait, which was not characteristic of any known nerve disease. For months he stayed indoors, and was said to be confined to his bed. After he had received full pay for over a year, I was asked to see him. His doctor, who had been in regular attendance, stated that he believed A. C. was suffering from myelitis. A very few weeks of separation from home, firm treatment, and a due proportion of plain speaking,

restored this man to his work with a rapidity which was inconsistent with organic or even functional disease. He was, in fact, a malingerer of the most pronounced type, and was astute enough to see that his doctor could not differentiate between feigned and real nerve disease.

In the last edition of his book on "Diseases of the Spinal Cord," published in 1895, about two years before the first Workmen's Compensation Act was passed, Dr. Byrom Bramwell pointed out that colliers very rarely suffered from organic disease of the spinal cord or its membranes as the result of pure and simple concussion of the spinal cord, and that *very rarely indeed* did these cases manifest the usual train of nervous symptoms which so frequently occur after railway accidents. He ventured to prophesy:—

"These conclusions may in the future be of no small importance, quite irrespective of the subject of railway accidents and injuries with which we are at present immediately concerned. The tendency of modern legislation is to compensate employees who have been injured, providing that the accident is not the result of their own carelessness or error. Now, I venture to predict that if the legislature should enact that colliers are entitled to compensation for the injuries so received, nervous symptoms will in the future be found to result much more frequently from falls of coal and stone on the back than is at present the case."

Those who are now engaged in colliery practice will appreciate the sagacity of this prediction.

Erichsen's "railway spine," or what was known as "concussion of the spine" (by which was meant concussion of the spinal cord), is now known as "hysterical spine" and is merely a psychical condition, which is particularly intractable to any but intelligent treatment.

Dr. Dickson, of Lochgelly, a practitioner of twenty years' standing in the County of Fife, stated at a meeting of the Medico-Chirurgical Society that traumatic neurasthenia was now a common topic of conversation in the villages of Fife, that the *moral* of the Fife miner, which before the passing of the Workmen's Compensation Act was high, had become much deteriorated, and that the duration of illness after accidents had become much prolonged; for instance, he stated that the average time for recovery from a fracture below the knee, which before the introduction of the Workmen's Compensation Act was three months, is now six months.

In many cases, unfortunately, it is not only the *feeling*, but also the *idea* of inability that must needs be expelled from consciousness in order to effect a cure.

A. D. was sitting at an open window when a boy threw a stone which struck her on the back of the head. She alleged incapacity and claimed compensation. On calling on her I was informed that she had been seriously ill; that she had gone to the seaside and was passing sleepless nights, the pain being incessant. She called upon me in two days' time. She was obviously a highly strung, neurotic, impressionable young woman. There was no mark of violence, and it was obvious that she was the victim of her own morbid introspection. She reminded me that she was a former pupil of mine, and implored me to suggest a remedy. She was told with much emphasis that she could be cured, but that the prescription would only be forthcoming if she definitely gave me her word that whatever I ordered she would obey. A solemn compact followed. I told her that her only cure lay in at once going back to work, which she did, and remained continuously at work for four months.

That many cases are psychic in their origin is shown by the fact that incidents which at the time have achieved considerable notoriety, and have had the most strenuous efforts of the sensational Press expended on them, are often followed by a number of cases of neurasthenia in which the actual traumatism has really been *trifling*.

A. E., was in a recent accident. He himself admittedly received but slight injury, nor was he concussed. The mental effect of the scene, which was in broad daylight, so took possession of him that shortly afterwards he was seized with violent spasmodic hiccough. This continued at intervals of a few seconds during his waking hours for over a year, but ceased when asleep. This patient was seen and examined by me in a London hospital.

Herbert Spencer points out that we remember for a long time with accuracy the spot in which an acute pain was felt, though the pain itself is not re-presentable with anything like its original acuteness. A man remembers easily, and for a long time, the circumstances under which he met with an accident, and its causal relation to his inability to work and legal claim for compensation, though he does not reproduce in consciousness, easily or at all *completely*, either the pain suffered at the time of the accident or the feeling of inability to work caused thereby. Yet by constantly recalling the circumstances of the accident and its relation to material gain he can keep alive *some representative part* of his (then) feeling

of inability; and this he can do almost indefinitely if the circumstances are favourable.

The problem is: How to expel this accidental inability, this indefinitely prolonged *re*-presentation of inability from his consciousness?

Frequently the happening of an accident so perverts the mental outlook of the victim that he persistently dwells upon and exaggerates all his unusual sensations, and in process of time they come to fill so large a portion of his field of consciousness that to a certain extent he genuinely believes that he is not fit for work. This belief, fostered by self-interest, and an unfavourable environment, grows at the expense of the rest of the mind, like the delusions of the insane, or the growth of malignant disease at the expense of the body. Physically these men are perfectly able to work, provided they have sufficient stimulus.

> A. F., who covered a wound $\frac{1}{16}$ inch in size with a large gout boot, three bandages, lint, and an ointment, seemed surprised, and I fancy not a little indignant, when most of his dressings were put on the fire, and he was told to resume work that day. The wound had gradually healed, but the fact that he *had been wounded* obsessed him.

The importance of environment in cases of accident is illustrated daily in homes where there are young children. When a child falls it may easily be prevented from crying by diversion, and attention, and encouragement to run about as though nothing had happened. The mentality of sufferers from shock, accident, and illness generally, is reduced more or less to the level of young children with their small powers of self-control, tendency to impulsive display of emotion, and marked suggestibility; this is, of course, especially true of sufferers from hysteria.

> A. G., a fireman, was struck on the shoulder by a falling comrade, who was killed. The blow was a glancing one, and injured him very slightly. He walked quietly to the fire station, went to bed, and, in the absence of the regular medical officer, was treated by a substitute, who did not recognize that the injury was more mental than physical. On the return of the medical officer he was encouraged to get out of bed, and in a few days he returned to work, which, however, he soon relinquished. An incipient attack of traumatic neurasthenia being recognized, he was sent to me. His appearance was that of one who was afraid of every movement he made. He held himself stiffly; his facial expression was one of deep melancholy.

He was consumed with introspection. It was pointed out to him that he had suffered no physical injury, and that it was his duty to pull himself together, that though his friend had been killed, he must not dwell on it, and that it was cowardly to behave as he was doing. I ordered him back to duty, making the proviso (*unknown to him*) that for a week he should do all the ordinary work of a fireman except ladder work, etc. I saw him by appointment after seven days; the change was remarkable. He had thrown aside his invalidism, declared himself well, and said he wanted now to do full duty, which was permitted.

This is a typical case of what is happening. Had this man not been employed in a service where medical supervision is strictly enforced, he would in all probability have drifted into a condition of typical functional disease, and had he been insured his case would have cost much.

It will be noticed that this case of functional disease, originally induced by shock and suggestion, was cured by powerful counter-suggestion; by forcing, as it were, into the patient's consciousness the idea that he was quite capable of doing his work if only he knew it. A continual succession of graded experiences was used to push out from the mind the delusive feeling of inability to work. That this line of treatment rests upon a sound theoretical basis is evident from psychological considerations.

The tranquil and often sympathetic environment with which these people gradually surround themselves is, as a rule, free from any sudden stress or commotion of any sort. The treatment must, as a rule, be by methods systematically applied and laboriously persisted in. Here is an exception:—

A friend told me that when he was house surgeon in the Middlesex Hospital, a lad, aged 15, was brought in. He sat in bed all day and slept all night with his knees drawn up, and was unable to straighten them. On several occasions he was given an anæsthetic, and the joints at once relaxed, but immediately contracted again on his recovering consciousness. Early one morning my friend was urgently summoned to see the patient who occupied the bed next to the boy's. He had been seized with an acute attack of mania and was wildly gesticulating with a knife. One nurse was sitting on his chest and others engaged in attempting to secure the knife. Another patient was in an epileptic fit from sheer fright, and the boy with the useless knee-joints had suddenly jumped out of bed and run downstairs! The interesting point is that the boy was made to live up to it and was cured.

The exhibition of sympathy fosters the increased sense of self-consciousness which is never absent. This egoism seems to be increased at the expense of the patient's appreciation of his surroundings. There is always some loss of sense of proportion of things.

Psychologists tell us that we conceive only that partial aspect of a thing which the individual regards, for *his* purpose, as its essential aspect. What is considered essential varies, of course, with the point of view of the individual. For instance, a piece of chalk is looked upon by different people according to the use to which it is put: the geologist thinks of it as the cemetery of millions of animalculæ; the schoolmaster, as a messy but useful aid to imparting knowledge; the chemist, as a carbonate of calcium. In short, the essential quality of a thing is its worth to the individual, and its value to him is its power to serve his private ends.

A feature of this class of case (practically never absent) is defective will-power. This probably is due in part to loss of memory of experiences and in part to the absence of the reminders which should come in from the environment. From lack of will-power spring the perpetuation and magnification of various morbid symptoms which are at first unresisted, then welcomed, then invited, and finally self-induced.

Neurasthenia is primarily a bankrupt condition of an individual's nervous force, whereas hysteria is a disease of self-suggestion.

The fact, however, must not be forgotten that hysteria *is a disease;* it is only the very young physician who thinks it is premeditated swindling. With the perversion of all healthy restraint there is nearly always some disassociation of the personality—a tendency to contemplation of the "other" self as a centre of interest. A very marked feature of hysteria, and of the self-pitying type, is the desire to be the centre of interest. Here we can again detect some "cloudy swelling of the self." Hysteria has been called a "disease of pose."

To put leading questions to a hysteric or a neurasthenic is almost an incitement to fraud. Hysteria has much in common with neurasthenia on the one hand and malingering on the other; all three, when associated with traumatism, are more or less curable by settlement of the legal claim.

Certain points concerning hysteria should always be carefully borne in mind; first, this disease has nothing to do with the sex

organs; second, no organic cause for the symptoms is known third, hysteria is not malingering, for the patient believes in the reality of the symptoms, whereas the malingerer knows better. The patient says, and believes, "I cannot"; the friends say "she will not"; the doctor says "she cannot will."

To simulate paralysis is thought to be a comparatively easy thing; to the uninitiated it seems sufficient if complaint is made of pain in the back, general nervousness, and loss of voluntary motor power of a limb or limbs. Fortunately, the simulator is unaware that true paralysis has characteristics, such as flabbiness, softness, and lack of tone of muscular tissue, which it is impossible to imitate. Organic paralysis never shows itself by the presence of one physical sign only; it is always accompanied by others which are beyond the control of the will. In simulated paralysis, when an attempt is made to move the limb, a certain firmness and stiffness of the muscles is sometimes detected at the moment when it is first handled, and when a limb said to be paralysed is held in an elevated position and then suddenly allowed to drop it is often momentarily held before it drops.

A genuine organic one-sided paralysis (hemiplegia) is soon followed by one-sided changes of the reflexes of a very evident nature. Paralysed muscles offer no resistance to their opponents, and consequently, contractions and deformities very soon appear. Even an artful rogue cannot make his muscles waste except by disuse, nor his nerves give the absence of electrical response known as the Reaction of Degeneration.

A very successful method of treating hysterical paralysis, say of the arm only, is to *demonstrate* to the patient that by stimulating the muscles with a weak electric current there obviously is no irreparable paralysis when even a slight voluntary movement follows. The patient is convinced of this, for he *sees* the muscle move. Progress towards recovery is, as a rule, continuous and marvellously rapid.

It is a matter of great importance to be able to diagnose a hysterical paralysis. Here is a typical case, which was demonstrated lately at the Post-Graduate College.

> A young girl, aged 25, alleged paralysis of the right foot. When asked to walk she put the outer side of her right sole gently on the ground, gradually leaning her weight on it; this was done with the appearance of much effort, and then suddenly, at the last moment, when one expected her to put her whole weight on it, the

ankle would apparently give way under her, so that the whole weight rested on the outer side of her foot. She then moved forward the left foot a little, and went through the same process again. The elaborate preparation for movement with the small result was typical of the hysteric's methods. When asked to sit down and move her toes separately she did so with a very irregular movement, at one time moving them fairly equally and freely, and at another slowly and with great difficulty. (This is very common in hysterical patients, and is brought about by their invariably drawing the opposing muscles into strong contraction, and it is typical of functional nerve disease.) When at rest she kept her foot strongly turned in, with the sole drawn upwards and inwards.

What are the conditions for which this might be mistaken? There was no wasting; therefore it was unlikely that serious organic disease was present. A one-sided hemiplegia was negatived by the fact that the face and arm muscles showed no evidence of any muscular paralysis.

The only other alternative was a paralysis of brain origin. We would expect there, however, exaggerated knee-jerks; on testing these they were found to be exaggerated. Now, the presence of exaggerated knee-jerks is, in my experience, of no importance if taken alone in proving that the disease is organic. It is a very constant accompaniment of hysteria and neurasthenia, and is, indeed, generally found in anyone who is suffering from any form of mental distress. If in this case the exaggerated knee-jerks were of any importance, they would be inevitably associated with other diseased conditions, which were found to be absent. By a process of exclusion, therefore, the condition was clearly one of functional paralysis. In searching for corroboration, irregular patches of anæsthesia were found upon the girl.

Since the passing of the Workmen's Compensation Act cases of functional disease have multiplied with great rapidity. The reason for this can be easily seen, for, whereas in former times the victim of an industrial accident had either to get back to work as soon as possible or break up his home and go to the workhouse, he is now provided for by legislation, and in many cases comes to regard his accident as a valid reason for living at the expense of his (former) employer. Moreover, trade unions, to save their own funds, sometimes, it is to be feared, encourage their members to live thus at the employer's expense.

Apart from the rare cases in which the absence of any conceivable motive leads one to suspect mental derangement, in cases of

malingering there is a direct advantage to be gained by the assumption of disability. The desire to obtain relief from irksome tasks, the sympathy of friends and relatives, or monetary gain, is the usual incentive acting on the minds of those with whose wiles we are here concerned. In the vast majority of cases the money value is the dominant consideration; and those who know anything of the Accident Laws of England will appreciate how they operate as an inducement for the exercise of an ingenuity which might almost be characterized by another term.

If men who, consciously or unconsciously, exaggerate symptoms in view of possible monetary gain were taught that a firm determination to turn a deaf ear to their perverted sensations, coupled with self-control, self-respect, and a return to work as soon as they were able, were of more service and more lasting value than many coins of the realm, much litigation would be avoided and true happiness ensue.

Speaking generally, it may be said that as labour has, for the most part, become more and more monotonous and irksome, the stimulus to return to work has become very much less than it formerly was; indeed it is sometimes non-existent, and the club member with his half wages compensation and club money is often better off when idle than when at work. The possession of club money deprives workmen for the time being of a good deal of necessary stimulus, and if they have an allowance under the Workmen's Compensation Act, or the expectation of a lump sum settlement or "damages," that deprivation may be prolonged for months or years; and the idleness in which they live during such lengthy periods always makes them more and more unfit for any really laborious work.

Morbid introspection is easily implanted on one who, accustomed to do laborious work, suddenly finds himself living in comparative ease on a pension or on club money, whose environment is converted into a sympathetic one, and whose new circumstances in almost every detail present a vast contrast to his ordinary everyday life before his injury. What wonder if he misinterprets various bodily stimuli which would in his ordinary daily life have been ignored!

A. H., who had been on the sick list for three weeks, was sent to me as he complained of a sprained right thumb. I discovered he had made the journey to my house from his home—a considerable distance—on his bicycle. As there was nothing apparently wrong

with his thumb, he was told that as he was able to ride his bicycle he was able to resume work at once, which he did.

Instead of again becoming useful members of society, these unhappy people acquire by irregular and loafing habits a mental outlook which renders them incapable of doing a honest day's work; and it follows that, in order to retain compensation, they exaggerate such symptoms as do exist, and attempt to introduce others which have no bodily basis whatever. Most of the alleged symptoms in these cases are subjective, and one is asked to depend solely on the patient's statements; and no one knows better than they how difficult is the position of the medical examiner when he has to found his disbelief in the existence of disease on grounds other than those of his own observation.

I have had for many years innumerable opportunities of watching sick employees in civil life at regular, definite intervals during the continuance of their illnesses—short, long, and even when they have become chronic—and I have been much impressed by the very definite relationship there is between the duration of an illness and the gradual loosening of the capacity for the work habit. It is of the first importance that a return to occupation, however light, should be recommended at the earliest possible time consistent with the nature of the ailment.

In diagnosing malingering it is impossible to formulate any symptoms or to lay down any rules; one can only come to a conclusion from a study of the symptoms presented and a careful consideration of the circumstances surrounding the case. In proving the positive malingering, one has to demonstrate the negative of the complaint alleged, and for this purpose it is usually necessary to show that the symptoms exhibited are a perversion of the normal.

Dr. Byrom Bramwell has defined a malingerer as one who feigns sickness or who deliberately (knowingly and wilfully) induces or protracts an illness, with the object of avoiding duty, claiming money compensation, exciting sympathy, or for any other reason. The same author points out that it is essential to draw a distinction between *malingering*, conscious and deliberate simulation of disease or exaggeration of symptoms, and *valetudinarianism*, unconscious or subconscious simulation of disease or exaggeration of symptoms.

A valetudinarian is one who is morbidly solicitous about his health. Many of these unfortunate men are converted into chronic invalids, or can be induced to return to work, according to the

attitude taken up by the medical officer. Much—very much more than is generally supposed—depends upon whether the medical officer throws the weight of his personality into one scale or another.

The attitude of a soldier who has been off duty for a long period, from whatever cause, is an exceedingly interesting study from the psychological standpoint.

Lord Justice Buckley defined a malingerer as one who is not ill and pretends that he is. "If he *bona fide* thinks that he is ill," said the Judge, "he is not guilty of that pretence."

The subtle distinction between unwillingness to return to work and a loss of will-power is not really obscure, though seldom recognized. What has been well described as the driving force of routine keeps most of us at the point of duty when we would much rather be elsewhere, and it is not difficult to see that when the habit of daily work is broken, in the case of those whose education is very incomplete and whose perspective is blurred when dealing with themselves in relation to their environment, delay in returning to work is by no means necessarily culpable laziness, but is due to obscure mental processes leading to defective reasoning for which they are not wholly responsible. Nevertheless, I am of opinion that, provided the physical disability which caused the cessation from work has ceased to operate, firmness and enforced return to work is always the best, and sometimes the only effectual method of cure.

> A. I., an employee, after being four weeks on the sick list, complained of being still unable to work owing to an injury to his knee. No abnormality was found and he was told to resume duty at once. As he did not do so, he was again sent to me a few days later. Still nothing could be found; he stated, however, that his knee swelled when he walked. Having measured his knee, I sent him out to walk for two hours. No swelling was discovered by measurement on his return. He was told to resume work forthwith, which he did.

Much more than half the battle in treating these cases is to prevent the acute condition becoming or being made chronic. The acute condition tends to become chronic if there is undue delay in settling claims for damages and so forth, or the lack of a friend in need to administer the right kind of suggestion and to help the mind to realize symptoms of improvement as they occur. A thorough medical examination, followed by a candid opinion, is invaluable in curing cases where pills, plasters and sympathetic

certificates are doing their evil work. There is no doubt that the condition is often made chronic by the suggestions of injudicious friends or *interested* parties.

A. J., struck his right knee-joint whilst at work. Two weeks later he was sent to his employer's doctor, who said he was fit for work. Five weeks later he was sent by the employer to another doctor, who said he was fit for light work. This he declined. A fortnight later he was seen by a third medical man, who said that he was fit for work on the level.

He was then sent to me. Careful physical examination showed that there was nothing whatever the matter with him. He complained that his knee gave way, and when asked to demonstrate it, he jerked back his knee-joint, making the whole knee stiff! By my advice his weekly payments were stopped. His solicitor withdrew proceedings and nothing more has been heard of the case.

This man had been off work for ten months for a trifling injury, and he was shamming most of the time. I am convinced that firmer treatment at the initial stages of these cases is the truest kindness. This man was seen by three examiners on behalf of his employers; number one said he was fit for work, number two said he was fit for light work, and number three hedged, saying he was fit for work on the level. Lastly, the employer, acting as a bad fourth, supplied him gratuitously with half wages and an elastic stocking.

Now, the knee-joint was either injured or it was not; either the man was fit for work or he was not. If a man is ill he should be treated kindly. If he is not ill he should be made to work. A strong line is best for all concerned.

One difference between physical suffering and the pain of a neurotic is that the latter satisfies unconscious longings and is sometimes profitable. Many a self-indulgent and lazy fellow, who never had an honest impulse for genuine hard work, seizes the opportunity a slight accident affords to convince himself, consciously or unconsciously, that he need not work. This may not be actual malingering but it is none the less contemptible.

All traumatic neurasthenics have the threshold of their consciousness temporarily lowered. The essential thing is to place the patient in the best possible circumstances. The successful lifting of the threshold of these people's consciousness above the level of the stimuli which are causing their discomfort can, as a rule, only be done in a new environment away from sympathizing friends. When in hospital, automatically, and by no effort of their own, their self-interest and self-pity are neutralized by their fresh sur-

roundings, and there are immediately fewer complaints. What is required is that these unfortunate people should be trained to realize that the consciousness of their sensations is to an extent self-induced, and that their duty is to help those who are trying to help them.

Next to the removal from their home circumstances is the influence of an independent, experienced and judicious nurse, and lastly, a doctor who is sure of his diagnosis, confident of his success from previous experience, and possessed of a strong personality.

Convalescents of this type do not improve in convalescent homes; although the furnishing is good, the accommodation clean, and the food wholesome, yet the whole environment is dull and dispiriting. The total absence of any attempt to provide wholesome occupation has a prejudicial effect upon those who are of the self-pitying, introspective type. In the best sanatoria patients convalescing from tubercular disease of the lungs are for many months before leaving expected to engage in hard laborious work. The late Superintendent of Frimley Sanatorium used to show with pride a large reservoir which his convalescent patients had dug for the institution. Too often a convalescent home reminds one of the epileptic or demented wards of a lunatic asylum. Sitting accommodation strikes one as obtruding itself everywhere; chairs are found arranged in groups; but nothing in the way of healthy, useful, purposeful occupation, such as carpentering, gardening, etc., seems to be thought of. Enforced idleness combined with segregation obviously opens the door to that interchange of medical experience so fatal to the convalescent stage of all diseases, especially neurasthenia.

Patients *in* hospital get thorough massage, and are, moreover, all the time subjected to the *massive* suggestion afforded by the hospital atmosphere and environment of discipline, and consequently they progress towards recovery.

The following case is illustrative of the value of this procedure :—

A. K., was engaged in a branch of the public service to which was attached a liberal pension. Seven years previously he had been off work for a whole year, suffering from a strained back; he received full wages and the use of a cottage. On this occasion, having been off work nine months with his back (again said to be strained), he was sent for examination with a view to superannuation. I sent him to hospital for observation. After eleven days he was told he would be reported as a malingerer, and lose his pension if he

did not immediately resume work. He left hospital and resumed work next day.

The following short table embodies a few of many cases which have come under my special notice during the last few years :—

(1) Sick pay for two years and one month for weakness of hand. Had been many months fit. County Court action, verdict for employers.

(2) Sick pay for four years seven and a half months for traumatic neurasthenia ; *eighty-seven days in hospital*, cured, case settled, went abroad, no further complaint.

(3) Sick pay for six years and eight months for alleged traumatic neurasthenia ; *forty-two days under observation in hospital ;* cured by arbitration proceedings, verdict for employers.

(4) Sick pay for six years for alleged pain in back and arm ; *sixty-one days in hospital*, cured, resumed work.

(5) Sick pay for nine months ; *eleven days' observation in hospital*, cured by plain talk, resumed work.

(6) Sick pay for fourteen months, traumatic neurasthenia ; *forty-five days in hospital*, cured, resumed work.

Neurotics who have met with an accident are as a rule much more in need of treatment than their traumatism.

Counter-suggestion of every kind must be employed to correct the re-presentation of the feeling of inability. This is best done by the provision of light and graded work. The hope of monetary gain is best discouraged by implanting a desire for the greater gain of health and self-respect. Counter-suggestion, if it is to succeed, must be immediate, forcible and continued, and must be applied at the psychological moment.

Now, what happens in the ordinary treatment of an accident in civil life? So far from counter-suggestion being immediately or presently applied, the patient is often subjected to the following factors which militate against return to work: "suggestion" by relatives, by the doctor, and later, by the lawyer. In cases which are contested the "law's delay" accounts for a great deal of prolonged disability and the development of functional disease. Too often the keynote of the situation is the desire for a lump sum settlement. Not infrequently the hesitation of the family doctor (who naturally sympathizes with his patient) acts as a powerful "suggestion" to the patient, that his illness is more serious and the outlook less promising than it really is. The one essential in the treatment of these cases is isolation from the

sympathetic environment which, if it is not the cause, certainly contributes to the upkeep of the condition.

Until the importance of early and proper treatment is recognized, and its provision enforced, the ever-increasing burden imposed by compensation to workmen will not be really checked or reduced.

Generally speaking it may be said that the more the accident results in actual physical injuries, such as broken bones, the less likelihood is there of serious nervous *sequelæ*, especially if the case is wisely treated from the first.

To sum up, in a large proportion of cases of alleged disability, the difficulty is to determine how much of the condition is due to the accident, and how much to the patient's mental outlook. Still more important is it to determine how much is the result of conscious or unconscious abandonment of self-restraint, together with a dim half-recognized appreciation of the supposed material benefits of continuing disability. These are some of the most thorny problems of medical jurisprudence. Many cases are effectively dealt with by firmness and persevering treatment, the essential features of which are change of environment, substitution of healthy for unhealthy suggestion, and the provision of adequate stimulus to return to work.

I am satisfied that often the best service a medical examiner can render to the State, when dealing with a difficult or obstinate case of hysteria or neurasthenia, is to procure admission into a hospital where these cases are understood and treated.

The following table sets out the results of one hundred consecutive cases, which I sent for treatment in Maida Vale Hospital for Nervous Diseases.

SYNOPSIS OF A HUNDRED CONSECUTIVE CASES OF NEURASTHENIA TREATED IN HOSPITAL.

	Total	Cured	Improved	Failure	Left hospital without permission	Average number of days absent from work before entering hospital	Average number of days treated in hospital
(1) Neurasthenia (traumatic)	32	17	4	8	3	465	61
(2) Neurasthenia (non-traumatic)	57	49	3	4	1	39	40
(3) Malingering (all accidents excepts one)	11	6	—	5	—	434	60

From this table given above it will be seen that out of 100 cases treated in hospital, no fewer than 72 were completely cured.

Of the remainder 7 were improved, 4 left the hospital of their own accord, and in 17 only was treatment a failure.

Success in medical examinations is in proportion to our knowledge of life. Life is made up of a number of little things which no one can afford to disregard. Each separately may sometimes appear unimportant, but the significance of their sum total is immense.

There are certain rules that must invariably be observed in making examinations of presumed malingerers. An accurate record of the tests made should be kept. These are very useful for production should occasion arise when your statements are questioned. Let your examination be thorough and watch everything, however trivial it may appear: the most unexpected incident will sometimes give the clue you are searching for. If any test is resisted, try another which, although apparently different, really has the same effect. If you have failed to get the result you require from a test, repeat it at a subsequent stage of the examination. Not infrequently a very simple test is of the utmost use, but the method of applying it determines its success or failure. Watch for the presence or absence of signs connected with one test, when the appropriate conditions are induced while performing another. A man may know enough to cause him to sway while you are performing Romberg's test, but will forget to apply his knowledge if you produce the same conditions while testing his vision. There is a great amount of folly displayed by malingerers, but they are not quite so foolish as to come before you without some idea of what their actions should be in the condition they allege. But it is a case of ignorance pitted against knowledge, and in the long run the issue should be certain. The success of the malingerer depends very largely upon his skill in filling in the whole picture, and, fortunately, his want of knowledge often renders him incapable of doing it.

While making an examination a sphinx-like attitude of complete detachment is the only safe course. A tactless examiner will never be a success, especially if he commits the fundamental error of provoking antagonism.

The enormous importance of making a painstaking and scientific examination, and of taking careful notes at the time of every result arrived at, will be obvious when we reflect that no examiner can possibly take the strong line so essential for successful treatment unless he is sure of his own ground, unembarrassed by misgiving

as to diagnosis and unimpeded by hesitation as to appropriate treatment.

The danger of allowing one's sympathies to carry one away, and of mixing up sentiment and business, as is so often done in County Courts in workmen's compensation cases, is that one is tempted to be generous at other people's expense. Sentiment is all very well in its proper place, but surely it should have no place when holding the balance between master and man.

Sentiment and business make an ill-matched co-partnership; it is so easy to pity the poor working man at the expense of his master. That gentleman probably has his own ways of dispensing charity; at any rate he has not commissioned you to do it vicariously. He places the medical man in the position of a judge when he asks him to state whether his workman is fit or unfit for work.

Two Irish priests lived together and shared the same room; one rose early, and during his morning walk was importuned by a passing peasant for a copper. He repeatedly told her he had none, but in response to persistent appeals, offered to feel in his pockets, adding that he would give her whatever he found. He was astonished to find half a sovereign, which he handed to her. Mightily pleased by what, no doubt, he considered was a charity, he returned to join his fellow-priest at breakfast. Having related the story with great gusto, and not a little pride, he was met with the chilling rejoinder: "Yes, but you had my breeches on!"

Every now and then one comes across a patient who is burning with anxiety to describe exactly how the alleged accident happened, and it is noticeable with few exceptions that those cases where the anxiety is most marked are generally the cases where there is little or nothing to be found upon examination. It is well not to encourage patients to give anything but a very brief description of how an accident has happened, for the working man's vocabulary is very limited, and he usually credits one with a knowledge of technicalities which most of us do not possess. It is useful to encourage the re-enactment and posturing incidental to the accident. Time after time I have allowed cunning rogues to give themselves away unmercifully, whilst they twisted and bent themselves in grotesque attitudes in their endeavour to show exactly the position they were in when the alleged accident overtook them. It is amusing to note the sudden check to their volubility, and posturing when it is pointed out that their free movements are presumptive evidence of their having at last returned to health and usefulness.

Many dishonest people think that in medico-legal examinations they must oppose *everything*, and not infrequently they oppose the straightening of the fingers, thus demonstrating the power of the flexors of the forearm.

In examining the muscles which bend the elbow the patient is asked to bend his elbow and to resist the straightening of it. For the shoulder muscles he is asked to lift his arms to a right angle to his body, and to resist the examiner's forcibly pressing the arms down.

Where the movements of a joint are limited, the exact nature, i.e., whether the limitation is of flexion or extension—should be stated, and the amount of limitation, expressed as a percentage of the normal, should also always be indicated. If possible an opinion should be expressed as to whether the limitation of movement is due to adhesions of a bony or other permanent deformity. If there are adhesions an opinion should be given as to whether they are soft or dense.

The instances of malingering which I have cited are intended to exemplify a point in diagnosis or assist in elucidating a problem. The following story, however, is not of any particular educative value, but I cannot refrain from quoting it, for to my mind it is an interesting example of malingering *par excellence* :—

> The vicar of a very poor London parish, well known for his practical but discriminating charity, made it a rule to personally visit all cases before giving assistance. Late one Christmas Eve, when his family were entertaining friends, a piteous message was sent to him to the effect that one of his parishioners had died, that there was no food in the house, and that the widow was at the door begging for a few shillings. The clergyman, urged by his family not to leave the house on such an occasion in such weather, for a storm was at its height, for once hesitated, but eventually interviewed the woman, and followed her to a tenement house, the dark, creaking stairs of which he ascended. When he entered the death chamber he saw lying on the bed the form of the breadwinner of the family, reverently covered with a white sheet. After some conversation with the widow, and writing out various soup and coal tickets, he took his departure. When half-way down the stairs he remembered that he had forgotton his umbrella, and rapidly returned, when to his astonishment the corpse was sitting up in bed chortling.

Clinical and other Notes.

CASE OF SHRAPNEL INJURY TO RIGHT PARIETAL CORTEX SHOWING PARESIS OF LEFT LOWER EXTREMITY, TOGETHER WITH CORTICAL SENSORY LOSS AND THALAMIC OVER-RESPONSE.

By Captain H. M. ANDERSON and Lieutenant H. L. C. NOEL.
Royal Army Medical Corps.

Private A. B., was admitted to a General Hospital on July 31, 1915, suffering from a wound of the head received on the 26th. After being hit by shrapnel he was unconscious for about ten minutes. He was carried to a dressing station, being unable to walk on account of weakness and numbness of the left leg. Since then he has complained of numbness of the left leg, and headache.

On admission there was a small perforating wound 8½ inches by 14¼ inches, 1¼ inches to the right of the middle line. There was no œdema of the scalp or tenderness of the underlying bone. The X-ray photograph showed two pieces of metal in the outer table of the skull in the posterior parietal region, with a depressed fracture below.

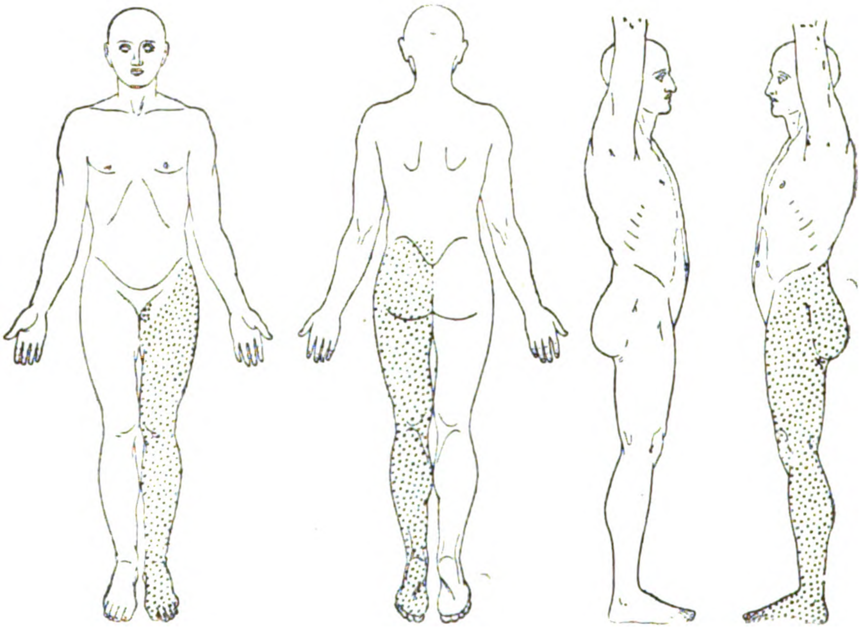
Examination of the nervous system revealed no abnormal changes in the eye movements, the pupils, or the visual fields, the face and tongue were straight, there was no weakness or ataxia of either upper extremity. The right lower extremity reacted normally to all tests.

In the left lower extremity all movements were possible, but there was definite weakness of the toes, and the extensor longus digitorum was observed to act more strongly when the patient dorsiflexed his ankle than when he attempted to extend his toes. On the left side the knee-jerk was exaggerated, ankle clonus was just obtained, the plantar reflex was extensor and the abdominal was abolished.

Sensation.—Over the dotted area shown in the figures there was marked over-reaction to pin-prick, and passing from above downwards the line of change was quite definite; over the whole limb moderate prick was less "sharp" and heavy prick more painful than on the right side. Over the hairless areas of the leg and foot there was blunting to cotton-wool touch, cotton-wool over hairs was well appreciated but felt different to right side. Temperature sense, vibration on bone and on pinched-up skin were normal. There was considerable persistence of deep touch from the sole, and compass points could not be distinguished at six centimetres along the inner border of foot. Position of the hip and the knee was impaired and there was complete loss of position of the toes. Localization was accurate. Spontaneous movements of an irregular and jerky

character affecting the whole limb occurred from time to time or could be elicited by any painful stimulus applied to the leg or by gently stroking the limb with cotton-wool, these movements were, however, most marked on tickling the sole of the foot or on gently pricking the left side of the glans penis, the latter causing great discomfort to the patient. Stimulation of the sole gave a feeling like an electric current passing through the leg.

On August 2 an operation was performed. A penetrating wound of the outer table was found with depression of the inner table, a blood-clot occupied the interval between the two tables. The depressed portion of



bone measured $\frac{7}{8}$ inch by $\frac{5}{8}$ inch and was driven down on to the dura to the extent of about $\frac{1}{4}$ inch. The dura was intact. After operation the sensory changes began to clear up rapidly. On his discharge to England on August 13 he reacted normally to gross tests.

This case is considered of sufficient interest to bring to notice as it shows a comparatively rare combination. There are two definite sensory changes to be distinguished. Firstly, there is the sensory loss due to functional disturbance, probably of a circulatory nature arising from local pressure on the post-Rolandic cortex. This accounts for the loss of posture, the inability to distinguish compass points, the persistence of deep touch, and possibly for the blunting of cotton-wool touch over hair-

less areas. On the other hand, we have to consider the over-reaction to stimuli of an affective nature such as heavy prick and stroking. This is of thalamic origin and is explained by the throwing out of action of the cortex, which normally exerts an inhibitory influence over the thalamus. The reason why thalamic over-response is seldom a well-marked feature of the cortical sensory lesions seen in this War it is difficult to say; in this case the amount of brain damage was small and the consequent shock light, a possible explanation. The area determined by the line of change is interesting in that it approximates more closely to a "mind" or hysterical loss than any other area due to an organic lesion.

On the motor side the involuntary movements are undoubedtly of reflex origin and probably represent the efferent expression of the thalamic level: in support of this hypothesis we have their relation to affective stimuli especially when arising from the mucous membrane of the glans penis. As such they are comparable to the well-known involuntary movements which accompany certain emotional states, such as shyness.

SPLINT FOR COMPOUND FRACTURE OF THE ANKLE.

By Major M. SINCLAIR.
Royal Army Medical Corps.

This splint was first applied to a compound dislocation of the right astragalus, but could be used for any compound injury in that region. Astragalectomy had been performed by Captain St. John D. Buxton, R.A.M.C., who asked me to suggest a method of fixation which would allow of easy access to the wound. There were minor injuries to the skin posteriorly, and great œdema due to septic infection of the foot and ankle as far as the knee. The ankle required frequent dressings, and the foot could neither be kept in good position nor quiet, and caused great pain to the patient. The splint was constructed to fix the foot at a right angle, to immobilize the ankle, and allow ready access for dressings.

The patient was in hospital for three weeks, and sent home in the splint, which proved so satisfactory for treatment and transport as to make its construction and method of application worth recording.

The splint was made out of the aluminium splinting from the Field Service fracture box in the following way: A length of aluminium of 40 inches is bent on its edge at F to an angle of 40°, at H to an angle of 130°, and bent on the flat at I to angle of 45°. A F = 15 inches, F H = 11 inches, H I = 11 inches, I J = 3 inches, total length = 40 inches. Another length of 40 inches is bent in the same way, having the staples corresponding and on the outside. These two pieces are

riveted at C and F parallel, and 6 inches apart with 8 inches by ½ inch by ⅛ inch aluminium. The transverse bar at F has a staple, K, in the centre, from which the foot is slung. Transverse bars of ribbon aluminium are fixed at B and E, and to these a sheet of perforated zinc 5 inches by 10 inches is laced with wire to form a smooth support for the sole of the foot. From D a strip of ribbon aluminium runs at right angles to F A as far as the point G. Another strip of aluminium ribbon runs from G to the corresponding point on the other half of the splint and the junctions at G are fixed by riveting. These supports give the necessary rigidity,

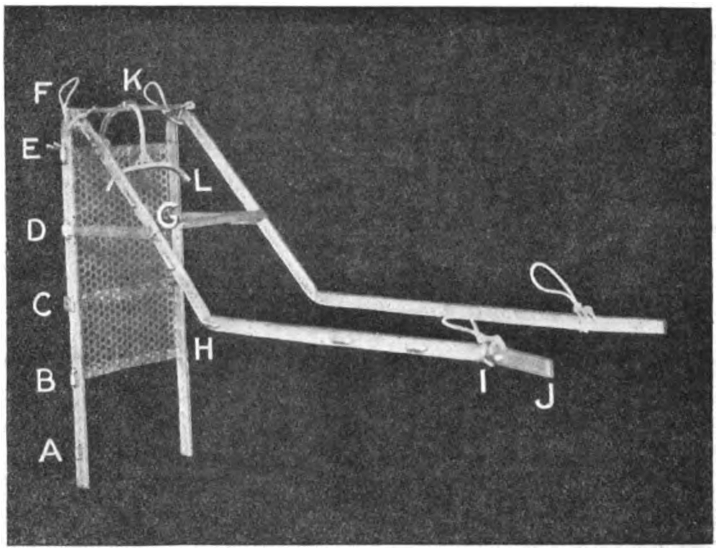


Fig. 1.

and prevent the angle at F enlarging owing to the weight of the limb, and the respective supports D G fix the ends of the bandage, which keeps the dressings in position. L is an arc of aluminium 4 inches in length, with a central staple to which a cord is attached. It is placed in the toe of a sock, in which is a small hole for the cord. The arc L acts as a spreader to prevent crowding together of the toes, when the foot is suspended. Four loops of cord are fixed at F and I to sling the limb to a modified Balkan by means of weights, cords and pulleys.

Cut a suitable cotton sock obliquely from heel to the middle of the instep. Insert the arc of aluminium L into the toes of the sock and allow the cord to pass out through a small hole at the extremity. Clean

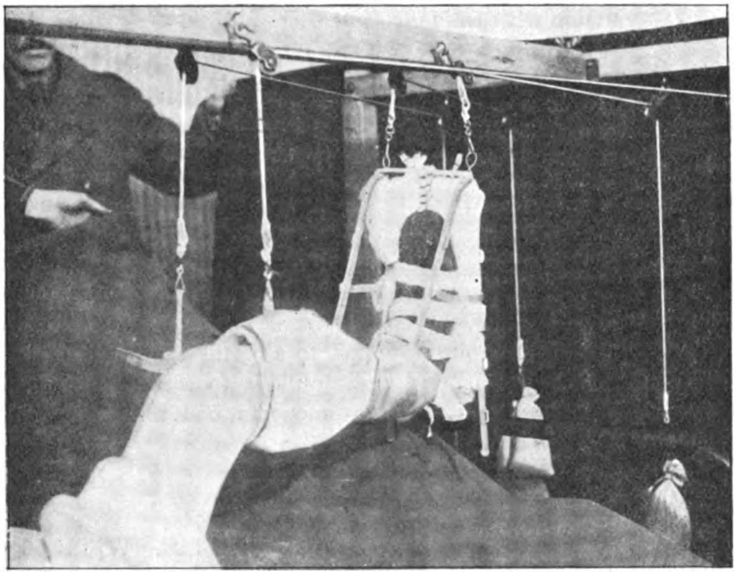


FIG. 2.

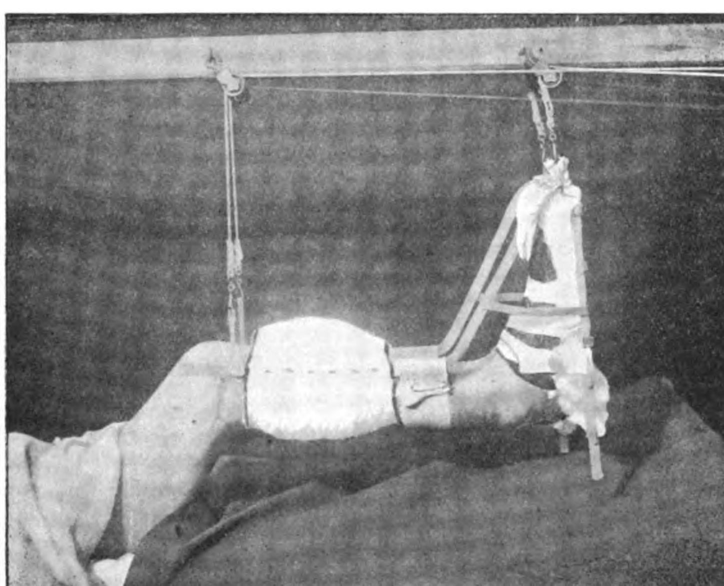


FIG. 3.

the foot with petrol or ether to remove the grease. Apply the sock dry, and paint its outside with the following preparation :—

℞ Canada balsam in xylol
Venice turpentine
Ether āā

When dry, place a layer of cotton-wool between the perforated zinc and foot, and fix the two together with a band of adhesive plaster round the dorsum. Adjust the cord from the arc L until the bars H I are parallel to the bones of the leg. Embed the latter in a plaster case extending down as far as convenient (about 6 or 7 inches) from the tuberosity of the tibia. Support the uncovered portion of leg with suspensions of elastic webbing or bandage. The foot is now fixed at right angles to the leg. Figs. 2 and 3 show the splint applied to a patient and slung by four cords, snap hooks, sandbags, and eight pulleys to a modified horizontal bar. This gives the patient free movement in bed, and the attendants free access to the wounds.

A CASE OF CEREBROSPINAL MENINGITIS, WITH PARATYPHOID "A" FEVER, COMPLICATED BY HERNIA OF THE SMALL INTESTINE THROUGH THE MESENTERY; OPERATION, RECOVERY.

By Late Temporary Lieutenant E. PARRY EVANS.
Royal Army Medical Corps.

The following case is worthy of record on account of its complication and eventual recovery :—

W. W., aged 21, was admitted to the isolation hospital, on September 24, 1915, with the provisional diagnosis of cerebrospinal meningitis. Four days previous to admission he commenced to suffer from general malaise, nausea with vomiting, drowsiness, sore throat with glandular enlargement. He continued at his duty, but on September 23 lost power in both lower limbs which, he said, were "too stiff" to move, and he reported sick on that date.

On admission, September 24: Pulse 100, respiration 24, and temperature 101·2° F. His mental condition was good, except that he was very lachrymose, crying repeatedly on the slightest provocation. Head retraction was marked and he complained of intense headache, more especially in the occipital region and back of the neck, which was increased on movement. The pupils were dilated but reacted to light and accommodation. There was slight photophobia, and he complained of pain at the back of the eyes. Kernig's and Brudzinski's signs were marked. He moved his lower limbs with difficulty and they were markedly rigid. His knee-jerks were increased, but there was no ankle

clonus. There was no hyperæsthesia and tache cerebrale was not obtained. His mouth was very dirty and throat injected, Clinically, he was a typical case of cerebrospinal meningitis, so a lumbar puncture was performed and fifteen cubic centimetres of clear fluid were withdrawn under pressure. As the fluid appeared clear no serum was introduced.

Lieutenant A. Banks Raffle, R.A.M.C., examined the fluid and found meningococci microscopically. Subsequently he obtained a pure culture of this micro-organism from the specimen.

On September 25 a lumbar puncture was again performed, fifteen cubic centimetres of fluid being removed, and fifty cubic centimetres of Mulford's antimeningococcic serum introduced without difficulty by the gravity method. I have found no danger in these cases from the introduction of a larger amount of serum than fluid withdrawn, if the gravity method is adopted. Meningococci were found in this specimen.

The following mixture was also prescribed :—

Hexamine	15 gr.
Sodii salic.	10 ,,
Pot. iod.	5 ,,
Aq. menth. pip...	1 oz.

One ounce every four hours in water.

This mixture was given as a routine in all my cases of cerebrospinal meningitis. It was continued in all until the slightest trace of blood was found in the urine, when it was discontinued for one day, repeated for two days, omitted on the third day, and so on, the urine being meanwhile carefully examined for albumin and blood.

The nose and throat were syringed four-hourly with liq. cresol co. 1 in 100, and calomel 3 grains, followed by mist. alba, was given as required for constipation, which is usually a marked feature in these eases.

Three hours later there was marked serum reaction, with temperature 104·2° F., pulse 116, respirations 24. He complained of intense headache and was excited and restless. There was great pallor and considerable collapse. He improved under stimulants, and twenty-four hours later was much better.

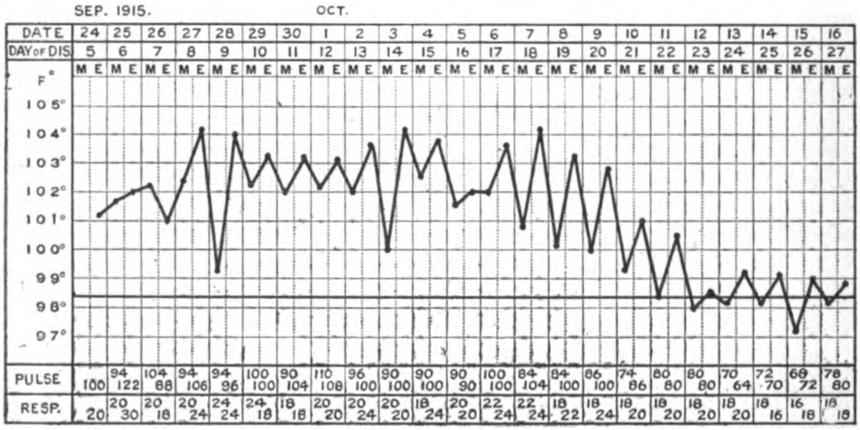
On September 28, 18 cubic centimetres of cerebrospinal fluid were withdrawn and 15 cubic centimetres of serum introduced; no reaction followed. Micro-organisms were not found in this specimen.

On September 29 hæmaturia was present, so hexamine mixture was omitted.

On September 30 his condition was as follows: Kernig's and Brudzinski's signs and head-retraction slightly present; headache much better. He could move his legs freely, though knee-jerks were still slightly exaggerated. On this date symptoms suspicious of enteric group fever were apparent. His temperature was of the enteric type, his abdomen tumid, with a suspicious roseolar rash, and the spleen was just palpable.

On examination of the blood the paratyphoid A bacillus was isolated. The patient's serum agglutinated the typhoid bacillus when in a dilution of 1 in 100, but did not clump the paratyphoid A bacillus.

Subsequent examination of the patient's serum made at intervals of four days showed that its agglutinating power for *Bacillus typhosus* remained constant, whilst that for the paratyphoid A bacillus rose, being



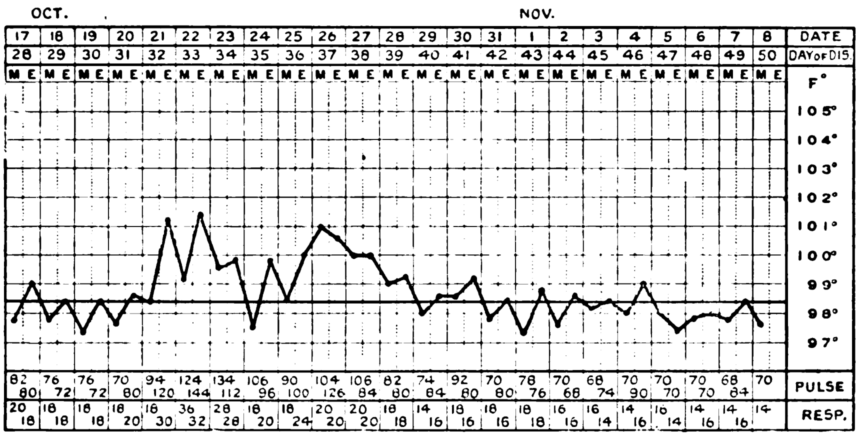
Day of disease—5, *e.*: Mist. urotropine, 4 hrly. On adm., 3.15 p.m., temp. 101·2° F. Lumb. pct., 4 p.m. 15 c.c. clear fluid withdrawn.
,, ,, —6, *m.*: Cal. gr. iii, mist. alba, ʒi. Lumb. pct., 10 a.m. 18 c.c. clear fluid withdrawn.—*e.*: Slight rigor, 1.30 p.m. 30 c.c. A.M. serum introduced.
,, ,, —7, *m.*: Mist. alba, ʒi.
,, ,, —9, *e.*: Omit mist. urotropine. Lumb. pct., 6.30 p.m. 18 c.c. clear fluid withdrawn.
,, ,, —10, *m.*: 15 c.c. A.M. serum introduced.
,, ,, —11, *m.*: Blood culture.
,, ,, —13, *m.*: M. bism. sal., gr. x, 4 hrly.—*e.*: Tc. opii, ♏v, 4 hrly.
,, ,, —14, *e.*: Cold sponge; temp. 104° F.
,, ,, —15, *m.*: Omit mist. sal.—*e.*: Tepid sponge; temp. 103·4° F.
,, ,, —18, *e.*: Sponged; temp. 103·2° F.
,, ,, —21, *m.*: M. mag. sulph., ʒi; and repeat at 10 p.m.
,, ,, —22, *m.*: Cal., gr. i, 8 a.m. M. mag. sulph., ʒi, 6 a.m.
,, ,, —23, *e.*: Cal., gr. i.
,, ,, —24, *m.*: Cal., gr. ii.
,, ,, —25, *e.*: Cal., gr. ii.
,, ,, —26, *m.*: Cal., gr. ii.
,, ,, —27, *e.*: Cal., gr. ii.

1 in 50, 1 in 100, and 1 in 400 on the second, third and fourth examinations respectively, as is frequently found in *Bacillus* A infections. Probably the agglutination of *B. typhosus* was the result of previous inoculation (February, 1915.) Paratyphoid B bacillus was not agglutinated.

For the following three weeks he ran the uneventful course of paratyphoid A fever, of more than usual severity, and his temperature had

been practically normal for eight days, when at 12 noon on October 22 he cried out owing to a sudden onset of intense pain in the epigastrium.

His condition on examination was as follows: Temperature 99·8° F., pulse 124, respirations 36, and abdomen rigid with no respiratory movement. There was diffuse tenderness on palpation which was more marked in the epigastric region. He was seen one hour later in consulta-



Day of disease—28, *m.*: Ol. ric., ʒvi.
" " —32, *e.*: Ol. ric., ℥i.
" " —33, *m.*: M. tc. dig., 3 hrly (1 dose given 6 p.m.).—*e.*: En. sap. c̄. ol. tereb., ℥i, 2 p.m. Operation, 9 p.m. N.S.S., Oiss. (intravenous).
" " —34, *e.*: En. sap. c̄. ol. tereb., ℥i.
" " —36, *m.*: Ol. ric., ʒi. Mist. alba, ℥i. En. sap. c̄. ol. tereb.
" " —37, *e.*: En. sap. c̄. ol. tereb., ℥i.
" " —39, *m.*: En. sap. c̄. ol. tereb.
" " —40, *m.*: Ol. ric., ℥i.—*e.*: Port, ℥i, b.d.
" " —41, *e.*: Ol. ric., ℥i.
" " —44, *m.*: Ol. ric., ℥i.
" " —45, *m.*: Sutures removed.—*e.*: M. f. et amm. cit., gr. x. Tc. nuc. vom., ♏ii, t.d.s., p.c.
" " —46, *m.*: Ol. ric., ℥i.
" " —48, *m.*: Ol. ric. ℥i.
" " —49, *m.*: Mist. mag. sulph., ℥i.—*e.*: Mist. mag. sulph., ℥i, 6 p.m.
" " —50, *m.*: Mist. mag. sulph., 2.30 a.m. En. sap., 5 a.m.—*e.*: Discharged to England.

tion with Major H. C. Donald, R.A.M.C.(T.F.), and Major G. Baillie, R.A.M.C., when the rigidity had passed off and he complained of practically no pain on palpation. There was no distension of his abdomen. His condition continued the same except that his pulse-rate rose steadily to 144, and there was a gradual increase in the rigidity of the abdomen, but he complained of no pain and repeatedly said that he felt all right. There was no sign or symptom of a recurrence of the cerebrospinal condition and a thorough examination failed to account

for the rising pulse-rate apart from the abdominal condition. Perforation was suspected and laparatomy decided on. His general condition was very bad, and one and a half pints of saline were given intravenously during the operation, with marked benefit to the patient.

The operation was performed by Major H. C. Donald, and it was found that a coil of small intestine had passed through a breach in the mesentery and was twisted on its axis. On untwisting the gut, it was easily withdrawn through the aperture in the mesentery. The intestine did not appear greatly damaged. The subsequent progress of the patient was without event; the laparatomy wound healing by first intention, and the patient was sent to England convalescent, on November 11, 1915.

The case was one of twelve suffering from cerebrospinal meningitis which were treated at the isolation hospital. The method of treatment described above for the cerebrospinal condition was adopted throughout and appears to have been particularly successful, as there were only two deaths in the series. All the cases were diagnosed bacteriologically, the meningococcus being found in the cerebrospinal fluid by Lieutenant-Colonel L. W. Harrison, D.S.O., R.A.M.C., and Lieutenant A. Banks Raffle, R.A.M.C.

TRESTLE FOR SUPPORTING FIELD STRETCHER.

By Colonel A. L. Bate.

Might I venture to refer to the interesting description in the Journal of the trestle for supporting field stretchers, invented by Captain McFayden, R.A.M.C. This trestle was very kindly first shown to me by Major Symons, D.S.O., R.A.M.C., and from a pattern he gave me, I had

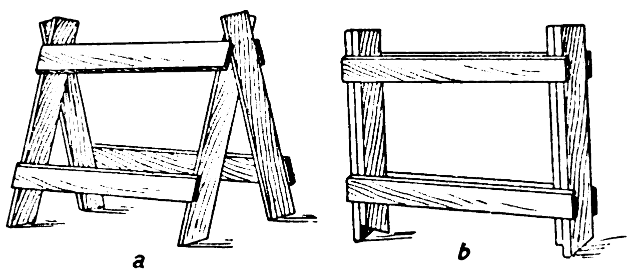


Fig. 1.—Trestle. *a*, open ; *b*, closed.

many made for the use of No. 4 Stationary Hospital. I have tried them constantly in a building and in camp since December, 1914. Major Symons pointed out to me the nails used in fixing the upper horizontal battens at each end as the weak point. This I am now able to confirm after

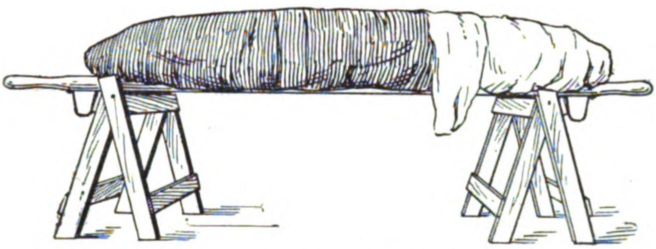


Fig. 2.—Bed improvised from trestles and stretcher.

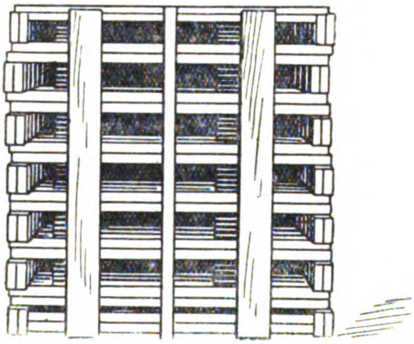


Fig. 3.—Bundle of eleven trestles packed for transport.

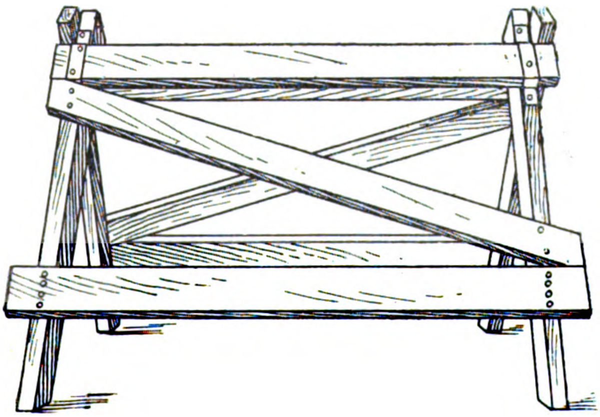


Fig. 4.

constant use. These nails loosen, and the trestle soon wobbles after use. I therefore took the liberty of introducing screws, which I believe Major Symons also suggested, where nails appeared to be unsatisfactory, but, in addition, I found it necessary to place a small piece of hoop-iron over the extreme ends of the battens on either side, just where the screw is introduced, and I also placed one extra batten on each side, extending from the upper and lower angles on opposite sides, diagonally outside, and fixed these battens by nails. These additions prevent the side-to-side movement caused by the loosening of the nails, while the screws and hoop-iron bands and extra battens keep the upper horizontal battens firmly fixed. Up to the present these additions have proved most satisfactory, rendering the trestle a most suitable support, and the additions cost very little. I secure the services of convalescent patient carpenters from time to time, who are quite capable of carrying out the simple necessary alterations, which makes the cost to me practically *nil;* the cost of the original trestle is one franc sixty centimes. My additions prevent packing into nests, as indicated to me by Major Symons, at least in the same numbers, owing to the position of the angular battens, thus adding to bulk when packed, while the weight is also increased, but as they fold up, they can still be packed with facility and easily carried about. These additions, however, cause much strengthening and permit of rougher usage, which certainly makes the trestle more serviceable and useful for the purpose intended, and therefore I think outweigh the disadvantages in weight and bulk, which my additions necessarily involve.

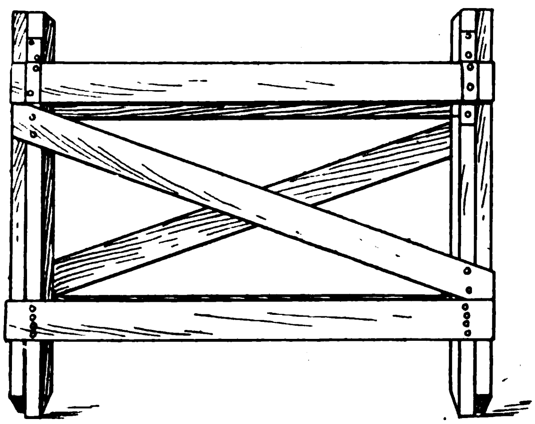


FIG. 5.

CRANIAL TUMOUR AFTER SHELL WOUND AND FRACTURE OF SKULL; DIFFICULT DIAGNOSIS. WAS IT A DERMOID BY INCLUSION?

By Lieutenant W. EDINGHAM CHRISTIE.
Royal Army Medical Corps.

Private R. T., No. 9441, was stunned by explosion of a shell on April 29, 1915. A blunt body must have struck the skull, for the skin was slightly wounded, and healed in a few days, but a tumour rose up within five days, and early in May it was about the size of a medium-sized orange. Though the patient had a sense of pressure inside his head, he does not think the tumour itself had pulsation in it at that time.

On arrival home about June a skiagram was taken and a fracture of the skull was seen at the edge of the tumour. The patient declined to have an operation performed. In October, 1915, I saw the man, and at first thought the tumour was a meningocele which had become shut off by healing of the fracture. It was round and fluctuating, and free from pulsation or expansion on blowing efforts. It had previously also been diagnosed as hernia cerebri by another surgeon. At this time I did not think it wise to operate. The patient was sent to Colchester, and was undergoing examination when he decided to return to his regiment. The skiagram taken then plainly showed the old fracture of the skull at the edge of tumour.

Having concluded that the cyst must now be shut off from the brain, I decided to operate, and on November 29, 1915, an incision was made, and the whole cyst was shelled out clean. It had no brain connection. It peeled off from the bare bone in the centre over the bregma. The fracture lay an inch away. It had upward raised edges so that some diffused pressure must have been made elsewhere by the shell explosion, or the body which was driven by it against the skull. On opening the cyst, hair and sebaceous matter was seen, and on the wall were a few white projections, but no teeth. The question then arose as to whether the cyst was a mere coincidence, or whether skin had been driven in by the shell, and caused a tumour by inclusion.

The officer in charge of the laboratory at Colchester was appealed to, and he answered as follows: "Section shows a simple dermoid cyst lined by about three layers of squamous epithelium, on the surface of which is shown sebaceous secretion. There are large numbers of sebaceous glands. It is impossible to say from a section whether it is a traumatic inclusion dermoid or of congenital formation. The site, of course, would give you much information towards settling the point. If it was in the region of one of the sutures, it would almost certainly be a congenital one."

As no tumour was noticed before the injury, and as the cyst was on a suture, it must be concluded that an embryo dermoid must have been incited to grow by the stimulus of the injury.

Up to date, January 20, 1916, there is no sign of recurrence.

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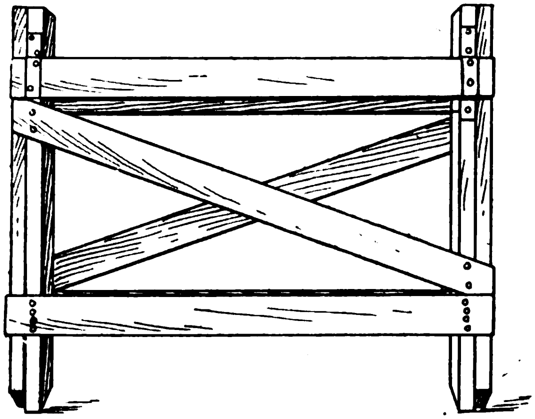

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Lecture.

THE IMPORTANCE OF GENERAL PRINCIPLES IN MILITARY SURGERY.[1]

By Major G. GREY TURNER.

Royal Army Medical Corps (Territorial Force).
1st Northern General Hospital.

I have chosen this subject for our lecture this morning because many of you will before long enter into the service of your country as military surgeons, and because the application of principles to practice is a most useful lesson for us all.

As you know, the military hospital with which I am associated is situated in a district in which there has always been a big garrison, and much of my work has been devoted to the ordinary surgical ailments arising among a large body of men and some special troubles connected with the training of the soldier. The latter is a matter which will repay review and with which I hope to deal at another time. To-day we are only concerned with the wounded returned from Flanders or the Dardanelles, the "over-seas cases" as they have come to be known.

To many of us the work of this campaign has been our only experience of military surgery, and at first we were mainly impressed by its novelty. One was led to adopt this attitude by the fact that military surgery is commonly spoken of as apart from everyday surgery. Books are specially written on military surgery; colleges are set apart for its study, and in the old days at our own school there was a Professor of Military Surgery. However, it was not long before I learnt that the principles which underlie surgical practice in general are exactly the same as those which govern the injuries met with as the result of modern firearms, and this is the lesson I wish to convey to you to-day. In nearly all the reports from the seat of war the need of guidance by general principles is being recognized.

The peculiarities which undoubtedly exist are due to the nature of the weapons and to the conditions under which the wounds are received and in which the injured man has to exist for some time afterwards. In other words, it is a question of environment, rather than any inherent peculiarity in the wounds themselves. May I remind you of the story told of Ambrose Paré, who was taught that gunshot wounds were somehow different from other wounds and were to be treated by very special means. Paré says:—

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[1] A Clinical Lecture delivered at the Royal Victoria Infirmary, Newcastle-upon-Tyne.

"I had read in John de Vigo, Book I, of Wounds in General, chapter viii, that wounds made by firearms partake of venenosity, by reason of the gunpowder; and for their cure he bids you cauterize them with oil of elders, scalding hot, mixed with a little treacle. And to make no mistake, before I would use the said oil, knowing that it was to bring great pain to the patient, I asked first, before I applied it, what the other surgeons used for a first dressing; which was, to put the said oil, boiling well, into the wounds, with tents and setons; wherefore I took courage to do as they did. At last, my oil ran short; and I was compelled, instead of it, to apply a digestive made of yolks of eggs, oil of roses and turpentine. In the night, I could not sleep in quiet, fearing some default in the not cauterizing, lest I should find those, to whom I had not applied the said oil, dead from the poison of their wounds; which made me rise very early to visit them; where, beyond my expectation, I found that they to whom I had applied my digestive had suffered but little pain, and their wounds without inflammation or swelling, having rested fairly well that night. The others, to whom the boiling oil was applied, I found feverish, with great pain, and swelling round the edges of their wounds. Then I resolved nevermore to burn thus cruelly poor men with gunshot wounds." (From "Confessio Medici," p. 65.)

This story is of peculiar interest to us to-day and conveys a very important lesson.

The Treatment of Wounds in War.

You will have read much during the last few months to make you think that the principles which, up to now, you have been taught to look upon as the basis of successful wound treatment, have been swept away by the same explosive blast that has shaken Europe. It has been said that antiseptics in war surgery are of no value, and some have gone so far as to infer that antiseptics are, therefore, useless in general. These statements have even got into the daily papers, and paragraphs have appeared to the effect that the whole principles of wound treatment have been upset by the experience of the past few months, and that all we have previously been taught is wrong and must be supplanted by what has been learnt as the result of the War. I venture to say that this will ultimately prove to be nonsense and in the meantime is a very dangerous doctrine. Many things have been learnt and much excellent work has been done, but nothing that has upset the principles laid down by Lister with regard to the treatment of wounds.

It is perfectly true that when the wounded man reaches a base or a hospital in England the greater proportion of the wounds are found to be infected, but this is largely a question of environment. Owing to the ghastly nature of modern warfare, the wounded may have to lie for many hours—men have spoken to me of lying for days—before they can receive any attention whatever, and the range of modern artillery

is so great that the attention they then receive is only of the nature of first-aid, for it is impossible at the dressing stations to do more; and it may be only after he had reached the clearing station, situated eight or ten miles behind the firing-line, that his wounds can have anything like adequate attention. Even in these latter hospitals after a big action, when large numbers of wounded pass through, it is only very few that can be dealt with as adequately as the principles of wound treatment demand.

Then, again, the wounds are often inflicted under filthy conditions, for the clothing may have been worn for many days or even weeks, and is nearly always soiled with earth which has been richly manured and highly cultivated for years and which is found to be teeming with organisms. Under these circumstances it can easily be understood that the possibilities of sepsis are infinite.

Further, the nature of the wounds themselves renders proper antiseptic treatment difficult, for they are often irregular and with numerous pockets and side-channels, and frequently contain foreign bodies which in their turn carry into the depths parts of the clothing or equipment.

What chance, then, has the ordinary antiseptic treatment of wounds when carried out with these numerous drawbacks? I know as the result of the experience of men from our own school that when war wounds are attended to before the organisms have actually begun to multiply in the tissues, that is to say within six, or in some cases even twelve, hours, then such wounds can be so treated with antiseptics that they do not become grossly infected and heal much as wounds so treated would heal at home.[1]

But you must clearly understand that the nature of many of the wounds, especially those produced by shells, makes them exceedingly difficult to cleanse, even under the best possible circumstances, and to thoroughly deal with some such would be quite a major operation taking a considerable time. I am afraid that unless the body can be protected against sepsis by some means without local interference, then we must always be unwilling witnesses to the septic infection of a certain proportion of wounds sustained in warfare. Lister always admitted that the antiseptic treatment of wounds was of more prophylactic than therapeutic value. What is now wanted is some plan to deal with infection when once started, and along these lines much promising work is being done.

But even when, as in the great majority of cases, the wounds do become infected, you are not to suppose that they are so peculiar, so "envenomed" as the older writers have it, that they refuse to yield to ordinary methods of treatment. Practically all the wounds that have

[1] Since this was written the value of antiseptics in "Wounds in Wars" has been endorsed by Sir Anthony Bowlby in his recent Bradshaw Lecture (see *Brit. Med. Journ.*, December 25, 1915).

reached us have been in a septic condition and nothing has given me more satisfaction than the way they have healed when treated by the ordinary antiseptic plan as carried out in this hospital. Lest any of you are strangers to our technique, let me say that for wounds already infected we largely rely on boracic fomentations, gauze wrung out of 1 in 1,000 perchloride of mercury and used moist, or a solution of the same strength made with methylated spirit, and at times irrigation with solutions of peroxide of hydrogen or iodine water.

One or two cases have been disappointing, but the great majority have done splendidly so far as wound healing is concerned. Of course, in the process of healing there are many stages, and the plan may have to be altered from time to time in the progress of the case and other adjuncts to recovery must be employed.

Drainage.

All who have had to deal with the wounded are insistent on the importance of drainage and, when one considers the undermining of the tissues, the masses of broken-down material that must be cast off by a suppurative process, and the pockets and side-channels which so frequently occur, then it is easy to understand the necessity of providing a free outlet for discharges.

The method of drainage is important and though tubes are undoubtedly the best means of bringing this about, there are abuses and dangers associated with them which we have learnt in the surgery of civil life to avoid.

Tubes ought not to be too big. They should be removed the moment they have served their purpose, and it is especially important that they should not be placed in the neighbourhood of blood-vessels, for in the presence of sepsis tubes are capable of producing erosion of the vessels, leading to very serious hæmorrhage.

Counter-openings are very useful and cannot always be superseded by the use of tubes. Quite recently I had to deal with a case in which a subcutaneous laceration had been produced extending down the whole length of the outer part of the thigh. The torn muscles were infected and sloughing and the patient was exceedingly ill. From a point near the trochanter a large tube, nearly a foot long, had been introduced throughout the whole length of the wound, but it was for the most part merely acting as a foreign body. The necessary requirements for the exit of discharges were met by making a series of counter-openings through which much shorter tubes were introduced and thus efficient drainage provided. This is an extreme instance, but the necessity of providing counter-openings should always be borne in mind. I would also draw your attention to the importance of position as an aid to drainage, and I was especially impressed by this in the case of a lad

who had been wounded through the leg and foot. The bullet entered about the middle of the inner aspect of the tibia and found an exit through the middle of the sole, "blowing out" quite a large focus from the bones which had been traversed. In consequence, there was a large funnel-shaped wound with the apex in the tibia and the base in the sole. The wound was grossly infected and there was a copious discharge of pus. In spite of free drainage, frequent dressings, passive congestion, and the use of sedatives he was constantly in severe pain as he lay with his foot propped up on a pillow. At this stage the case was seen by my friend, the Rev. Robert Stirling (now a Lieutenant in the Royal Army Medical Corps), whose experience of gunshot wounds sustained in the civil life of the Holy Land makes his advice especially valuable at the present time. He suggested that the pillow should be removed and the head-end of the bed raised so that the discharges could constantly run out of the wound. The effect was very striking, for pain immediately ceased and recovery was greatly aided.

One further illustration refers to a similar condition in the humerus in which the wound of exit lay over the head of that bone. This man kept developing secondary abscesses half-way down the arm in spite of a tube introduced right into the medullary cavity. When the foot of the bed was kept raised so that gravity aided the escape of pus this trouble was got over and recovery was much hastened by this simple expedient. In this case a counter-opening about the middle of the arm might have served the same purpose had not the simpler plan succeeded.

Another principle which we have re-learnt during the last few years is the importance of fresh air in combating infections. (This was well-known to our forefathers, and in his delightful account of Alanson, of Liverpool, my friend, R. W. Murray, shows how he insisted upon it one hundred and thirty-eight years ago.) Though principally exploited in connexion with tubercle its usefulness is not limited to the ravages of any particular organism. My septic cases have improved enormously when kept on the balcony or in open tents both day and night, and I believe that no single factor has been of more benefit to patients poisoned with sepsis than the free use of the open air. An illustrative story will suggest to you what happens under these circumstances: Two practitioner friends met in the street. In response to an inquiry by Dr. M. as to what was doing, Dr. P. said he was sorry to confess that he had a case of puerperal sepsis. Dr. M. enquired how the case was getting on and was interested to hear that it was progressing favourably towards recovery. Curiosity being stimulated, Dr. M. next asked how the patient was being treated and was informed that she was having antistreptococcic serum. He remarked on the great expense of the treatment, to which Dr. P. replied that it was costing nothing, for the patient was manufacturing the serum herself!

There is a wealth of meaning in this story, for there can be no doubt

that if by fresh air, good food, etc., you can help the patients to make their own antitoxins; they will do it more surely and much more safely than you can possibly do it for them. But you must not think that I do not believe in the use of artificially prepared antitoxins, etc. I have to regret three instances of death from septicæmia in both its acute and chronic forms which I cannot help feeling might have been cured by some form of antitoxin or vaccine had we been sufficiently informed to know exactly what strain was required. The use of antitoxins and vaccines for the cure of surgical sepsis undoubtedly occupies an important place, but at present it is far behind the other measures which we can employ.

FIG. 1.—Separated and necrosed fragments from a case of gunshot wound of the pelvis.

Fig. 1.—Some large sequestra which I recently removed from the ilium. The patient was a soldier, aged 39, who was wounded on April 26, 1915, by a piece of shell which passed through the right half of the pelvis, shattering the ilium and producing a large wound of exit. The wound was almost necessarily septic and there was profuse purulent discharge. Twenty-two weeks after the casualty he was transferred to Newcastle to be nearer his own home. When admitted on September 27 he looked much older than his reputed age, and was very lethargic and with a tendency to be discontented. The temperature was irregularly elevated and the pulse wanting in tension. He took food badly and generally felt ill and miserable. There was a large sinus over the centre of the ilium in the position of the exit wound from which flowed a copious discharge of offensive pus and at the bottom of which bare bone could be felt. Here, then, was a man

presenting all the signs of a chronic intoxication from sepsis. He had been carefully treated in hospitals in France and at home, but absorption still continued. With careful dressing and feeding he certainly improved a little, but it was not much, and at the end of a fortnight he was much as before, and with a not very hopeful outlook on life. As about six months had elapsed since the infliction of the injury I judged that there would be good formation of new bone and that the sequestra might safely be removed. The fragments shown you were extracted under anæsthesia, and the cavity left, which was almost big enough to hold the fist, was packed with gauze soaked in turpentine. The improvement was immediate and remarkable, for his whole temperament appeared to change and he became bright and cheerful and has made a splendid recovery.

I quote this case to show the importance of removing a septic focus and the great benefit which follows. It is a principle in surgery which is apt to be forgotten, that all the gross sources of sepsis ought first to be dealt with before falling back on vaccines, etc. In these cases it is largely a question of proportion or perspective, and the great thing is to remember to first remove the cause as far as possible, and then to adopt the other measures in the order in which they may be expected to do the most good.

When we come to the question of serum-therapy in prophylaxis we are on very hopeful ground. You will remember that last session I spoke to you on this matter in connexion with the prevention of tetanus (*Durham University College of Medicine Gazette*, December, 1914), and now I am glad to say that for many months past we have scarcely had a single case, due to the fact that the wounded men are all getting a prophylactic dose of antitetanic serum. The importance of this measure was very well illustrated by the experience of my colleague, Captain Heslop. In one batch of thirty-two wounded admitted to his wards only one man had not had a dose of antitetanic serum, and he developed acute tetanus on the twelfth day which proved fatal in thirty-six hours.

Latent Sepsis and the Recrudescence of Sepsis in Healed Wounds.

That septic organisms often lie dormant in war wounds has frequently been illustrated and has been remarked on by most surgeons. One often sees cases of gunshot wound in which the patient goes on perfectly well for two or three weeks and then without any demonstrable cause there is an outburst of sepsis. Such an outburst may take the form of local inflammation only, but there is often cellulitis, lymphangitis and grave constitutional disturbance due to absorption (sapræmia) or to the presence of the actual organisms in the circulating blood (septicæmia). The condition is not always a relapse, for the manifestation may be much worse

than any primary septic trouble which has been present, and it is not necessarily due to the introduction of fresh infection, because it can occur with healed wounds and without any breach of the surface whatever. I have frequently noticed it after the amputation of fingers shattered by gun-fire, and it may occur as the result of massage or the movement of previously infected joints. Sometimes tetanus has been lighted up in this way, though I have not myself seen it.

As bearing on this problem it is well to remember that the organisms of tetanus and gas gangrene have been found in gunshot wounds, but without either of these diseases resulting. It is, then, feasible to suppose that they may get locked up in the tissues, only to give rise to their specific infections when conditions for their development are more favourable.

That organisms or their spores may survive for long periods is proved by the case of a Belgian who was under my care in October of 1914, with multiple shrapnel wounds of the arm. Six weeks after the casualty he developed symptoms suggestive of tetanus, but they were very mild, and I always doubted the diagnosis. Exactly twelve months afterwards he developed typical tetanus and passed through a long illness with dangerous exacerbations.

The most serious instance which I have come across was that of a corporal, who was admitted to the military hospital on July 30, with numerous small wounds on both legs, the result of a bursting shell. The wounds were not looked upon as serious and there was only little irregular pyrexia, the temperature never rising above 100° F. nor was the pulse ever above 80. The wounds soon became healthy, granulating sores, and the patient was getting on so satisfactorily that he was up and walking about. On August 27, he went out without his great-coat, staying out of doors for a considerable time. He felt cold and poorly at night and next day had a rigor. The right leg became swollen and painful, presenting the signs of a severe cellulitis with lymphangitis and enlarged groin glands. Symptoms of severe general infection rapidly developed, with a temperature of 103° rising to 104° F., and on the day of his death—a week after the onset—reaching 106° F. Post-mortem examination showed evidences of death from general septicæmia without any other cause than the wounds on the legs.

These conditions are certainly very striking though not peculiar to war surgery, and there must be some general principle involved. Many years ago when on a voyage from the Gulf of Bothnia I sustained a scratch over the right elbow in the course of my efforts to help the crew to right a cargo of iron ore in anticipation of the severe weather which followed. I thought nothing of it at the time, but on arrival at home about a week later developed a severe cellulitis which was very painful, made me feel quite ill, and which had to be incised. In the course of two or three weeks everything seemed all right again and I had no

further trouble until exactly twelve months later when, without any reason which I could assign, the cellulitis recurred and was sufficiently bad to require a further incision just by the side of the old one. The following is a brief note of a case occurring in a soldier which illustrates the same thing:—

A man was wounded on April 25, 1915, a small fragment of shrapnel lodging in the neighbourhood of the knuckle of the ring-finger on the left hand. It was only a very slight wound and after removal of the fragment it healed in three days. He thought nothing of it, although occasionally the place ached a little. Some time after this a high explosive shell burst close to him and he was invalided home with shell concussion. August and September were spent in the country, and on the 25th of the latter month, when in splendid general health, the injured finger suddenly swelled up and became very sore, while the pain went up his arm and the glands in the axilla became enlarged. There was a little local infection, a small abscess bursting and discharging. There was no sign of any foreign body. After a few days the whole thing cleared up and he was all right again.

The Reopening of Healed Wounds.

Another trouble which is sometimes spoken of as if peculiar to war wounds is the breaking down of a scar apparently completely consolidated, but in these cases there is often a definite and tangible cause.

Fig. 2. — Sequestra from the ulna, the cause of the reopening of a healed wound.

A soldier was wounded on May 16 as the result of the bursting of a hand grenade. He sustained a shattered fracture of the lower end of the ulna, and in France some portions of shrapnel were removed. On May 25 he was admitted to the 1st Northern General Hospital with a healthy granulating wound which was apparently soundly healed at the end of a month. He was sent to a convalescent home, but he had not been there long before the wound broke down and discharged. It again healed, and was apparently all right when the same trouble recurred and delayed his return to duty. At the end of eight weeks the wound was apparently perfectly sound, and after inspection by an experienced surgeon he was marked for sick furlough and return to duty, but on the day on which he was to leave the home the wound again commenced to discharge and he was readmitted to the 1st Northern General Hospital. An X-ray photograph showed there was still some necrosis, and under an anæsthetic I found a small cavity which contained the sequestra shown in fig. 2.

After their removal the wound healed from the bottom and gave us no further concern.

Another similar case was due to a metallic foreign body :—

A young private was wounded in May by the bursting of a hand grenade. The right knee, left leg and left foot were each injured, and in France portions of casing were removed from all the wounds. They all healed soundly except that on the foot, which healed and broke down many times. After being in hospital four months he was discharged with the wound healed, but ten days later it again re-opened and he was admitted to the 1st Northern General Hospital. He then presented a scar on the outer part of the dorsum of the left foot with a small unhealed area at one end. No foreign body could be felt, but X-ray examination showed a metallic fragment imbedded in the os calcis. At the operation for its removal the foreign body was found imbedded in granulation tissue which was directly connected with the under surface of the scar.

Sinuses.

It is an established principle that a sinus is to be looked upon as a symptom and not a disease, and before any consideration of treatment it is necessary to make a diagnosis as to its cause. Nothing is more common than to see men wounded at the War who for some considerable time afterwards, when in perfect general health, present a sinus, discharging more or less pus and a local rather than a general inconvenience.

Sometimes a gross foreign body, such as a portion of projectile, is still in situ, but these are the simple cases that are not likely to be missed. Such an example is that of a man who was wounded at the Battle of the Aisne on September 13, 1914. The bullet entered the upper part of the right thigh just about the trochanter. He was treated at various hospitals and was finally given sick furlough for a month. During all this time the wound never completely healed, and on December 9 he was admitted to the 1st Northern General Hospital with a small sinus just above the trochanter on the right side. The X-ray photograph demonstrated a shrapnel bullet, and under an anæsthetic this could be easily felt and was removed together with a portion of garment. The sinus promptly healed and the patient was soon able to be discharged cured.

I have recently had under my care a man, aged 22, who was wounded in the right thigh by the bursting of a bomb on July 16, 1915. A piece of casing was removed from the back of the thigh by a separate incision on July 24. The wound made for the latter purpose healed almost at once, but the original wound continued to discharge and he was admitted to the 1st Northern General Hospital on July 30. The original wound was quite small and was represented by a sinus which passed right across

the thigh to the inner side. Nothing could be felt with the probe, and X-ray examination was entirely negative. The patient himself was perfectly well, but every now and then there was a considerable discharge of pus from his wound which never completely healed. Rest, with irrigations and suitable dressings, certainly caused a diminution of the discharge but did not to obliterate the track, and on September 18 under an anæsthetic I explored, and after enlarging the external aperture removed a

FIG. 3. — Showing comminution and necrosis of the femur, the result of a bullet wound.

FIG. 4. — Sequestra removed from the same case as the preceding figure.

piece of clothing about an inch square, evidently a portion of the man's trouser. After this the sinus rapidly closed and the man had no further trouble.

Another frequent cause is the formation of a sequestrum, and the numbers of sinuses which are due to this are very remarkable. In military surgery a very considerable injury to the deeper tissues may result with a very small wound of the superficial parts, and I show you on the screen an X-ray photograph of the femur (fig. 3) together with the sequestra (fig. 4), which were subsequently removed in the case of a man

whose thigh was traversed by a bullet from front to back. The casualty happened on May 15 and he came under my care on June 20 with a sinus leading down to the femur. On September 26 the sequestra which I show you were removed, after which the sinus began to heal.

SECONDARY HÆMORRHAGE.

In connexion with this subject well-established surgical principles are constantly being exemplified, and it is interesting to know that these principles were first formulated as the result of the experiences of a great military surgeon—George James Guthrie—who gained his knowledge in the Peninsular Wars chiefly between 1808 and 1815, when he operated on many of the wounded from Waterloo. His "Commentaries on Surgery" will well repay study at the present time. Guthrie showed conclusively that in cases of secondary hæmorrhage the bleeding very often came from the distal end of the injured artery, and that it is therefore necessary to expose the artery at the site of the wound and to tie both ends rather than adopt the plan of the proximal ligature, which was the favourite method up to his time.

A very striking illustration of this principle was furnished by the case of a man who was wounded in France by a bursting shell which ploughed up the tissues over Scarpa's triangle. The femoral had to be tied just below Poupart's ligament, and the patient was admitted under my care some days afterwards with gangrene of the leg and a deplorably septic wound all over the front of the thigh. I had scarcely left the hospital after seeing the case when I was hurried back on account of alarming hæmorrhage. The patient was exceedingly ill, and had lost so much blood that I thought the ligature applied to the cut end of the femoral artery must have given way. As a matter of fact, the bleeding was from the end of the profunda femoris which was lying exposed in the wound, the parent trunk having sloughed away. This, then, was an admirable instance of secondary hæmorrhage from the distal end, or rather a distal branch of a severed artery. Had the ordinary principles been neglected and the external iliac artery ligatured, the hæmorrhage would probably not have been arrested or would have recurred owing to the freedom of the collateral circulation. Though the patient was exceedingly ill, he rallied sufficiently to allow me to amputate the thigh a day or two later, ultimately making a complete recovery.

ON THE REMOVAL OF FOREIGN BODIES AND THE USE OF THE RÖNTGEN RAYS.

You cannot see much of military surgery without being confronted with the problems connected with the removal of foreign bodies, nor will you be long without appreciating the enormous value of the X-rays. Let me state very clearly the conclusions at which I have arrived as to

the removal of foreign bodies from patients arriving at a base hospital at home.

Firstly, I think that in the great majority of cases it is a wise thing to remove a foreign body, if this can be done without running any grave risk so far as the life of the patient is concerned or the function of the part affected. We get almost daily confirmation of this, because we are constantly getting patients admitted to hospital whose wounds are healed and who have returned to duty, but who do not feel happy in their minds because of the knowledge of the presence of some extraneous foreign body in their anatomy. I find that it makes all the difference in the world to a man whether his foreign body is in his chest wall or his waistcoat pocket. It is after all a pyschological matter in many cases, and if by such a gross mechanical performance as a surgical operation you can lift a permanent load from the patient's mind, then it requires strong reasons before you should desist from your efforts. Of course, I know that some people say directly and many imply that the discovery of the X-rays has been anything but a benefit to the wounded, but if certain principles are always kept in mind then this taunt is unjustified, and, first, you must clearly recognize that if you cannot do good you have no business to run the risk of doing serious harm.

FIG. 5.—A diagram made from an X-ray photograph. A fragment of shrapnel was lodged at the point *A*, and there was a large mass of callus at *B*. The longitudinal fissure was only disclosed on X-ray examination, the injury having originally been looked upon as trivial.

Secondly, no one should undertake the removal of a foreign body without very careful consideration as to its exact position and relation to surrounding structures. An operation for its removal should never be carried out without an X-ray examination, because so often there are multiple foreign bodies or there are concomitant injuries to bones which can be dealt with at the same time. No attempt should be made to remove foreign bodies without careful localization unless they can be certainly felt near the surface. As the foreign body is always potentially a source of infection the area from which it has been removed should always be drained.

I would also plead for the routine use of the X-rays, even in cases in which the foreign body can be felt or in which the lesion, whatever it may be, is apparently perfectly obvious. It is wonderful how many revelations one gets, and often in cases in which the injuries have been apparently trivial. Let me tell you of the case represented in fig. 5.

This man was injured by shrapnel in the lower part of the right thigh. There was a small sinus on the outer side leading to a piece of metal apparently quite close to the surface. An X-ray of the immediate vicinity only showed a foreign body lying just inside the cancellous tissue of the bone. The problem seemed very simple, and it looked as though the case was almost a trivial one, but on examinatian I discovered a large hard swelling in the upper part of the inner aspect of the thigh. It was smooth, hard, and scarcely tender, but there was a little increased heat. Had there been no question of injury it would certainly at first give rise to the suspicion of a sarcoma, or it might have been an enormous gumma. However, an X-ray picture of the whole femur showed a crack extending from the point at which the foreign body was impacted halfway up the shaft and then across the inner aspect of the bone, the mass being represented by a large amount of callus thrown out about the latter, and probably due to the fact that the patient had not had adequate rest, no serious injury to the bone being anticipated.

Instances of this kind are very common. I would only refer you to the case of an officer who accidentally shot himself with his revolver. The bullet entered over the front of the tibia, four inches above the ankle-joint, and a very tender point just in front of the ankle-joint and apparently not far under the skin suggested the position of the missile. X-ray examination showed that the bullet had really traversed the tibia from just below the wound of entrance to its lower end, producing an amount of injury which would never have been suspected either from the symptoms or from any physical signs.

With regard to the actual removal of missiles, I think we have retrogressed a little. In the old days when Nelaton's probe was invented the efforts of the surgeon were almost entirely limited to the removal of foreign bodies via the wound of entrance; and I would like to remind you that this is a method which is still sometimes exceedingly useful.

If a foreign body can be easily felt with the probe, and if an X-ray examination confirms the position, and the fact that it is single, then to remove it through the original track is often a simple matter, and I have several times been successful, and especially with the round shrapnel bullets which were so frequent in the early days of the War. Of course, it is sometimes necessary to enlarge the wound of entrance and the aperture in the deep fascia, but nowadays we have the aid of anæsthesia which our forefathers lacked, and this greatly increases the scope of the measures with which they had to be content. If the wound of entrance and the track have healed, then it is often expedient to remove the foreign body by some shorter route, cutting on to it directly.

With deeply situated foreign bodies and foreign bodies in inaccessible parts, you cannot have too much information, and I would urge you never to attempt the removal of foreign bodies without an X-ray plate or plates as a guide. Very frequently the radiographer marks the site of

the foreign body exactly and gives an indication of its depth, but without the plate some important point may be missed which may have a great bearing on the success of the operation.

In a case in which a rifle bullet was embedded in a rib, the wound of entrance was on the surface of the back and close to the point at which the bullet was seen to be lying by the screen. It was accurately localized and I foolishly attempted to remove it without having seen a plate. To my great disappointment I failed to find the bullet, but at a second operation the knowledge that it was actually embedded in the rib made its removal quite easy.

In our X-ray department some simple devices have been found most useful. For instance, it has been observed that when a foreign body is near the surface it can easily be made to move by pressing over its site during a screen examination. We have also found a screw-driver used as a pointer to be very useful, and wires have been found of value in the localization of bullets in the chest and in the head.

Always beware of making ill-considered attempts to remove small foreign bodies embedded in muscular parts, and, indeed, they are of minor importance, because they are scarcely likely to give rise to much trouble in such situations.

At the beginning of the War and for some time afterwards foreign bodies in the chest were supposed to be in sacred ground, and patients were universally advised to have them left alone. Being impressed with the amount of mental anguish which some of these men appeared to endure because of the knowledge that they had a foreign body in their lungs, I have now on four occasions deliberately opened the chest and removed bullets or shell casing, and in each case with complete recovery.

On the Need of Ordinary Methods of Examination.

Nowadays, with so many special methods of examination at our disposal, we are all apt to forget the routine plans which have stood us in such good stead for so many years. I have indicated the extreme value that I attach to X-rays, but they should not be used to the exclusion of other and simpler methods of examination.

These points were well illustrated in the case of a man who was wounded in the left side of the back and who complained of persistent pain on defæcation. There was no wound of exit and a fruitless search had been made for the foreign body, the whole of the left side of the back and pelvis and all down the left thigh being X-rayed. When he came under my observation, in the course of routine examination I palpated the rectum and found what I took to be the foreign body lying on the right side and within easy reach of the finger. The presence of a shrapnel bullet in this situation was confirmed by the X-rays, and was subsequently removed by an incision to the side of the coccyx and with complete relief to the symptoms.

In another case a man was shot by a rifle bullet which entered above the right hip and which was followed by some paresis of the limbs, with retention of urine and incontinence of fæces. It was thought that the bullet had lodged somewhere in the spinal canal, but on careful examination with the screen it was discovered on the outer side of the left thigh in a position in which it could easily be felt had we examined him systematically with a knowledge of the vagaries of bullet injuries in our minds.

In a similar case the bullet had entered in the middle of the left buttock and could easily be felt lying just under the skin in the middle of the front of the right thigh.

In traversing wounds of the limbs it is remarkable how blood-vessels and nerves can be missed, but it is most important never to assume that these structures have escaped and to be constantly on the look-out for evidence of nerve injury or blood-vessel trouble.

In civil practice it is unfortunately quite common to see paralysis of important nerves after wounds of the limbs have been dealt with and have healed satisfactorily, and it is well always to make it a rule to examine all the nerves that might possibly be injured. A dropped wrist or foot is usually very obvious, but there may be a lesion of some other nerve with less characteristic symptoms that may be overlooked.

The same thing applies to the blood-vessels, and in the case of a man who was wounded through the calf as well as in the head and knee it was only many weeks after the accident that a systematic examination disclosed a slight swelling of the limb, together with a widespread purring hum, which was the only evidence of an arterio-venous aneurysm involving both the posterior tibial and peroneal arteries.

In dealing with possible blood-vessel injuries it is also very necessary to re-examine the patients from time to time, for in one case a traumatic aneurysm gave no evidence of its presence until twenty-six days after the casualty, and in another case a man who was peppered with shrapnel on May 15 was sent to a convalescent home on June 12, apparently making an excellent recovery from what was considered to be a trivial injury—yet on June 25 he suddenly developed a large pulsating swelling behind the knee which proved to be a traumatic aneurysm of the popliteal artery.

The same need of careful examination is exemplified by injuries to the chest. These are commonly thought to be beyond the scope of surgery and to merit very little attention, but they are all worthy of very careful examination from time to time and for long intervals afterwards. This is well illustrated by the case of a serjeant from whose pleura I removed a bullet under the following circumstances:—

The man was shot on May 8, 1915. The bullet entered in the centre of the sternum just below the manubrium, but there was no wound of exit. He suffered from shortness of breath and pain in the chest and for a

time had a high temperature. These symptoms gradually improved and in three weeks he was sent to England. On June 24 he was allowed to go home on sick furlough, and at the expiration of this time rejoined and started work at recruiting. He managed fairly well for a week and then had to give up on account of shortness of breath. When admitted to the 1st Northern General Hospital careful examination showed very definite signs of an empyema at the left base, from which I removed the bullet, complete recovery following.

In ordinary surgical practice the best diagnoses are made when time is taken to go carefully into the history, and the same rule applies to military surgery. This was borne out by the case of a man who was admitted to the hospital because he was supposed to have a bullet in his lung. He had certainly been shot from behind and had spat blood, but on going carefully into his history he volunteered the information that immediately after the accident he saw the end of the bullet sticking out of the front of the chest like a nipple, though the swelling which followed almost at once pushed the skin away and thus obscured the protruding missile. In this case the bullet was found lying on an intercostal space just in the position described by the man, and from which it was removed with the greatest ease.

Gunshot Fractures.

In fractures due to injuries by firearms there are some special points which you ought always to bear in mind. The first thing you must realize is that the injury to the bone very often bears no kind of relation to the size of the superficial wound, the extent of damage to the underlying muscles, or to the shock of the casualty. For instance, an injury due to a bullet may present only tiny wounds of entrance and exit and yet the bone may be extensively comminuted; whereas in certain types of shell wounds all the soft tissues may be torn away, leaving the bones bare but uninjured.

Cracks and fissures[1] are exceedingly common and are frequently very extensive, the whole of the shaft being sometimes involved. With such injuries there may be no deformity, abnormal mobility, or want of alignment, and men may even walk or use the affected limb, and it may not be until there is an excessive amount of unexpected callus that the fracture becomes evident. These considerations make routine X-ray examination absolutely essential in helping us to estimate the amount of damage sustained by the bone. It may be as well to remind you that such examinations are worthless, or nearly worthless, unless photographs are made in two planes.

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[1] "A *crack* is a cleft whose sides are very near together and can hardly be seen; a *fissure* is a visible cleft whose sides are widely separated."—Delorme.

Extensive comminution is the most characteristic feature of gunshot injuries of bone, and it must be recognized that there may be comminution both with and without separation of the fragments. It is this extensive comminution without separation which robs these cases of many of the signs which are characteristic of the fractures of civil life. A bullet may pass through a bone making a regular trephine opening with or without complete fracture or comminution; or the foreign body may be lodged in the bone or in the neighbouring soft parts. When fragments are driven into the soft tissues they may produce very extensive wounds at the point of exit, and it is these cases which commonly give credence to the stories about the use of "Dumdum" bullets. Sometimes quite a mass of bone may be shot clean away—a focus blown out—leaving a gap in the shaft. Splaying out of bone fragments about the track of the bullet is another common feature. It can therefore easily be understood that the ordinary signs of fracture are frequently absent, and the only safe rule is to suspect every case, and to make routine use of the X-rays.

In the leg and forearm it is fortunately common to get a gunshot fracture of one bone only, so that the other remaining intact acts as a very good support.

The surgeon must always be on the look-out for concomitant injuries to vessels and especially nerves.

So far as the wounds are concerned the same principles ought to guide us as in the treatment of compound fractures sustained in civil life. A most important point is to resist the temptation to remove loose fragments (fig. 6), for there is abundant evidence in surgery to show that bone is the best stimulus to the formation of bone. It is impossible to say how much bone will live or die, and this is a question which can only be settled by Nature, and in almost every instance she spares more than one would expect.

I know there is a great temptation to use plates and screws, but for my own part I have not yet made up my mind that this is good practice in compound fractures, and it will take a good deal of evidence to show that internal splinting is to be accepted as a principle in the treatment of gunshot injuries.

But though you are apt to be appalled by the amount of injury to the soft parts or by the amount of shattering which has occurred, you must not forget that the factors which lead to disability in similar fractures produced in civil life will also operate in these cases. This has frequently been exemplified in connexion with the bones of the forearm, and I pass round the photograph of a case of a class which is not at all uncommon. The man has been shot through both bones of the forearm, and you will see that the fragments have united in such a way that he is unable to fully supinate the hand, doubtless because more attention was paid to the wounds than to the position of the bones.

The next photograph (fig. 7) shows a similar fracture at the junction of about the middle with the lower third of the radius. In that case the same disability existed, but in an exaggerated degree.

The next case I would mention is one in which a bullet went right through both bones of the forearm. Entering on the inner side it found an exit at a point just opposite where the fragments of bone which were driven forward by the bullet had produced a very extensive superficial laceration.

Fig. 6.—A gunshot fracture in which the comminuted fragments were removed. There was no sign of regeneration six months after the casualty. The gap was subsequently bridged by a bone graft.

Fig. 7.—A gunshot fracture of the radius which had been allowed to unite with the hand in the prone position.

In all these cases the important thing is to deal with the fracture so that the bones of the forearm are kept fully supinated. In this way the patient will acquire the best functional result, and on this the ultimate usefulness of the limb will depend. It does not much matter how the arm is put up to secure this full supination so long as the end is attained. It is not a question of some special splint or piece of apparatus, but of a principle which must be borne in mind. Personally, I prefer to use two straight splints made of gooching and extending from just below the shoulder to the extremity of the metacarpus. The fixation of the splint to the upper arm secures complete supination of the forearm, and in actual practice this plan has been most efficient.

The same thing applies in the case of those fractures at the lower end of the femur, where there is backward displacement, as in the supra-condyloid fracture of civil life. Under these circumstances the displacement must be met by flexion of the knee, and the neglect of this precaution, though it may not interfere with union, often gives rise to a very crippling amount of disability with regard to the movement of the joint.

Similarly, gunshot fractures of the upper end of the femur ought to be treated with the limb abducted if the best results are to be obtained. In most cases the principle of extension must be employed, and this more so than in civil life, because so often there is great shattering of the bone or actual loss of substance. Carrying this out often gives rise to much trouble in the lower limb, and a great deal of ingenuity has been exercised in the manufacture of apparatus for this purpose. In the upper limb the problem is simpler, and for the fractures of the humerus which are so common, the weight of the limb can usually be relied upon to secure the necessary amount of extension and with excellent results.

Most of my cases of gunshot fracture of the humerus are simply treated by suspending the wrist in a short sling, sometimes with the addition of pieces of gooching applied over the seat of fracture and fixed to the chest with a circular bandage.

It cannot be too much insisted on that bones require rest and time for their repair, and this is especially important in military surgery where the presence of sepsis so often delays union. Aching and tenderness at the site of the fracture are a sure sign that repair is not yet complete and are an equally certain guide as to the necessity of further rest.

Injuries to Joints.

The surprising way in which many of these injuries recover with a good range of movement has frequently been a matter for comment, but nevertheless all cases do not end so favourably, and after the War there will be an enormous number of ankylosed joints scattered over Europe. Since it is usually impossible to tell at an early stage of the case whether or not ankylosis will occur, it is very important to deal with these cases in such a way that should such an untoward result follow the limb will be in a useful position. This rule should always be followed whatever the cause of the joint injury, but it is especially exemplified by the number of cases met with in military practice.

I mention the case of a man who sustained a bullet wound through the elbow-joint followed by severe sepsis. The arm was treated at a right-angle, and as ankylosis followed the usefulness of the limb was much interfered with.

Injuries of this joint should be treated in a position midway between a right-angle and full flexion, for this is certainly the most useful should

ankylosis occur. It is then easy to reach the mouth, to brush the hair, to get at the coat pockets, etc. Of course, such a condition may subsequently be treated by arthroplasty, but it may be that the patient will not submit to any interference or there may be some other reason why it should not be carried out, and therefore it is imperative to treat these joints in the most useful position at the outset. This equally applies to the wrist, for should it become ankylosed neither excision nor arthroplasty gives any certainty of a good result. Cases with shattered joints, such as that shown in fig. 8, should all be put up in the dorsiflexed position, for then the grasp is strong and the hand very useful. If ankylosis takes place with the wrist slightly flexed, as so often occurs, the grasp is very weak indeed. It is easy for you to test this matter for yourselves and you will be surprised at the difference the position makes to the usefulness of the hand.

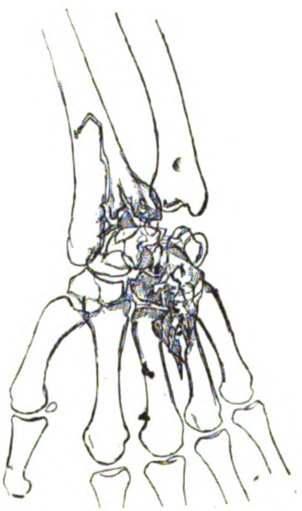

Fig. 8.—Shattering of the carpus and adjoining parts, the result of a gunshot wound. A case to be treated in the dorsiflexed position.

If the shoulder is the joint affected the arm should be kept fully abducted, for this materially increases the range of movement obtained through the scapula and also prevents the annoyance of the arm constantly rubbing against the side.

In the case of the lower extremity, the hip should be slightly flexed and abducted. When the knee is the joint affected it should be kept a little flexed; while in cases of great destruction of that joint it is most important to prevent the outward and backward displacement which is so apt to occur. When the ankle is involved, the foot should be slightly pointed, for this much diminishes the loss of elasticity which a fixed ankle-joint entails.

What has been said about the length of time necessary for recovery in fractures and about the significance of persistent tenderness, especially applies in cases of joint injury. My experience has taught me that "more rest and less massage" is a very sound axiom in dealing with joints that have at one time been infected. If John Hilton, the gifted author of "Rest and Pain," could but revisit this globe, he would be delighted to find that the principles he so wisely upheld have stood the test of time.

Injuries to Nerves.

My time is almost done, but I do not want to omit to impress on you the need of care in the treatment of paralysed parts. Great pains must especially be taken to keep the muscles, whose nerve supply is cut off, in

a state of relaxation so that the recovering nerve will not find them so overstretched that much valuable time is wasted in "taking up the slack." This is best illustrated by a reference to musculo-spiral paralysis, where the dropped hand means harmful stretching of the extensor tendons, easily provided against by the wearing of a simple straight forearm splint during recovery.

The Psychological Factor in War Surgery.

The influence of mind over body is an important factor which is well recognized by all who have to deal with the sick, and it is especially so in our military work. Here we are dealing with men who are frequently a very long way from home and friends; who have suffered the fatigues of war, and have often for the first time been introduced to many of the horrors that follow in its wake. These men are not normal in mind—there is often a temporary loss of balance, and it is a wonderful commentary on the amount of backbone possessed by our nation that the wounded are so constantly cheerful and bright in spite of their great trials. But it is most important that you should recognize this aspect of the matter, and it says much for the wisdom of the authorities that as far as possible they arrange for wounded men to be sent home to England as soon as they are fit to travel. To be once again in their home-country and within reach of friends does much to help recovery in bad cases. Similarly, the bright surroundings of our hospitals are valuable therapeutic agents and they ought to be aided by a cheery optimism which I think it will not be difficult for any of you to cultivate. Always remember that one of the most valuable and cheapest remedies we possess is Hope.

Reviews.

A Practical Guide to the Inspection of Meat and Foods. By A. E. Bonham, Chief Sanitary Inspector and Superintendent of the Public Abattoirs, City of Exeter, etc.

However good the intention of the author has been, and he emphasizes this fact in his preface, to furnish a practical guide for the use of sanitary officers, he falls far short of its accomplishment. He has attempted to cover the syllabus of the Royal Sanitary Institute for the examination in meat inspection.

Far too much space in the book is devoted to the consideration of physiological and pathological data, with which he appears ill-equipped to deal. This portion of the subject would have better been omitted altogether, or else collaborated with the help of a qualified veterinary surgeon. It is doubtful, however, if the mass of ill-digested detail furnished would be of much use to a sanitary inspector. To a medical Officer of Health it is wearisome and full of inaccuracies.

It is a matter of regret that more thought has not been given to the arrangement of the subject matter in that portion of the work in which the author shows first-hand knowledge. In many instances the grammar is not above suspicion.

There is much that is good in this little book, particularly the description of anatomical and physiological distribution of lymph glands and lymphatics, with the practical instructions for their dissection. But the author omits to state the importance to the meat inspector of an accurate knowledge of these glands.

The appearance and characteristics of fresh, frozen, chilled and pickled meat, etc., are well described; but the chapter (V) is spoiled by the inevitable introduction of pathological details, which have nothing to do with the subject matter of the chapter.

In Chapter VIII the author deals very clearly and succinctly with the Hygiene of Cowsheds, Slaughter-houses, and Food Storage in general. Chapter IX, on the Stalling of Animals and their Preparation for Slaughter, is equally instructive. But in these chapters he has had no opportunity of losing his way among the devious paths of veterinary science.

We hope that in a future edition the author will see fit to adhere more closely in the text to the practical side of the subject, in which he is an expert, leaving the scientific and veterinary descriptions in more conversant hands. A. B. H.

Physiology for Nurses. By W. B. Drummond, M.B., Ch.B., F.R.C.P.Edin, Edward Arnold. Pp. 210. 81 illustrations. Price 2s. 6d. net.

In this handbook the author has succeeded in representing in clearly arranged and simple form, the essential facts of physiology, together with an amount of useful anatomical information.

As an elementary text-book the general result is excellent, provided the reading is intended to be accompanied by a practical course, the necessity for which is not sufficiently indicated.

As a handbook for nurses the value and interest of the work would have been increased if the requirements of the nurse had been more kept in view and the practical bearing of the subject more fully dealt with. This could have been done at the expense of some of the detailed descriptions, which could well have been written in broader outline and with a greater elimination of detail. Especially in view of the fact that nurses so often control diets, both in health and in sickness, more space could profitably been devoted to the economics and therapeutics of dietetics.

The author has been successful in combining general accuracy with simplicity, though in some instances the facts are not quite so simple as are stated. For example, on p. 47, the impression is given that diabetes is due to the failure of the liver to store carbohydrates. There are some other statements that would fail to secure general assent. They are, however, relatively unimportant.

The illustrations and diagrams are well chosen and correspond with the text. J. B. O.

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Original Communications.

INOCULATION OF MAN WITH MIXED VACCINES CONTAINING *BACILLUS TYPHOSUS*, *B. PARATYPHOSUS* A, AND *B. PARATYPHOSUS* B, WITH REGARD TO THE REACTION PRODUCED AND THE ANTIBODY FORMATION.

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FOLLOWING on experiments with rabbits,[1] a series of experiments on man were commenced.

The men inoculated were divided into five groups—A, B, C, D, and E.

These groups consisted of men who were inoculated with the following vaccines:—

Group A.—Men in this group received a single dose of one cubic centimetre of a vaccine containing the following:—

Bacillus typhosus, 1,000 million per cubic centimetre; *B. paratyphosus* A, 500 million per cubic centimetre; *B. paratyphosus* B, 500 million per cubic centimetre.

This vaccine contains a trypsin broth culture of *B. typhosus*

[1] JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, November, 1915.

grown for forty-eight hours, and was heated for one hour at 53° C., after which lysol was added to such an amount that the final lysol content was 0·4 per cent.

The paratyphoids were grown separately on trypsin broth agar in Roux bottles for forty-eight hours, washed off with normal saline, heated for one hour at 53° C., and then had lysol added as in the case of *B. typhosus*. Standardization was carried out before killing by counting by the dark-ground method in a shallow cell, counting chamber. The three vaccines were then mixed so as to bring about the final strength as stated above.

Group B.—Men in this group received a single dose of one cubic centimetre of a vaccine in which the *B. typhosus* was grown on agar in the same way as the paratyphoids. The final strength of the vaccine was the same as in Group A.

Group C.—Men in this group received a single dose of one cubic centimetre of a vaccine made in the same way as in the case of Group A, but the final strengths were as follows:—

B. typhosus, 1,000 million per cubic centimetre; *B. paratyphosus* A, 750 million per cubic centimetre; *B. paratyphosus* B, 750 million per cubic centimetre.

Group D.—Men in this group received two doses of the vaccine used in Group A. These doses consisted of 0·5 cubic centimetre, and one cubic centimetre given at eight days' interval.

Group E.—Men in this group received two doses of the vaccine used in Group C, i.e., the mixed vaccine containing *B. typhosus* 1,000 million, *B. paratyphosus* A and B, of each 750 million per cubic centimetre. Two doses were given, 0·5 cubic centimetre and one cubic centimetre, at ten days' interval.

Reports on Reactions Produced.

The reactions in Groups A, B, C, and E were observed by one of us (C. J. C.) on men of the Royal Army Medical Corps at the Depot at Aldershot.

The reactions in Group D were noted after inoculation of men at the Royal Army Medical College.

Groups A and C.

The inoculations were carried out at the Royal Army Medical Corps Depot, Aldershot, on recruits who had not been specially selected, except in so far as was necessary to ascertain that they had neither suffered from enteric fever nor had been previously inoculated.

The men were inoculated between the hours of 2.30 and 3.30 p.m.,

on Friday, December 3, 1915. They were ordered to parade at the Medical Inspection Room at 6 p.m., to have their temperatures taken; a number failed to come, but this appeared to be due to a misunderstanding about orders rather than to the effects of inoculation. These men's temperatures were taken in the barrack-rooms. They paraded again at 8.30 a.m. on the following day, and also at 6 p.m.

All the inoculated returned to duty on Monday, December 6. They had been excused duty on the Saturday and Sunday.

Seventy-three men were inoculated with one cubic centimetre of a vaccine containing *B. typhosus* 1,000 million, *B. paratyphosus* A and B, of each 750 million (Group C).

Forty-eight men were inoculated with one cubic centimetre of a vaccine containing *B. typhosus* 1,000 million, and *B. paratyphosus* A and B, of each 500 million (Group A.)

When the inoculations were commenced it was discovered that a great number of the men had been recently vaccinated against small-pox. As there were no other men available it was decided to carry on the experiment with these. After a certain number of inoculations had been done in the left arm, the remainder of those showing signs of inflammation due to cow-pox were inoculated in the right arm. In this way a greater number of the "500 million" series were inoculated in the vaccinated arm than was the case in the "750 million" series.

The onset of the reaction appears to have been definitely earlier than is usual with the ordinary antityphoid vaccine. A considerable number of men stated that they began to feel ill from two and a half to three hours after inoculation.

Local Reaction.—This was definitely more severe than is usually seen in the case of inoculation with one cubic centimetre of typhoid vaccine alone. Nearly all the men showed a considerable area of redness and swelling; a few showed signs of inflammation extending along the lymphatics, and a great number complained of pain extending into the axilla. There were no cases of swelling extending to the elbow or lower. The local reaction was slightly more marked in those getting the 750 million *B. paratyphosus* A and B than in those getting 500 millions.

General Reaction.—The following table shows the temperature at the three periods after inoculation: (1) evening, four hours after; (2) morning, seventeen hours after; and (3) evening, twenty-seven hours after.

The figures indicate percentages of men inoculated—those who

had the 500-million dose of *B. paratyphosus* A and B, with "500" against them, and those who had the 750-million dose of *B. paratyphosus* A and B, with "750" againt them.

Temperatures upwards of		103° Per cent.	102° Per cent.	101° Per cent.	100° Per cent.	99° Per cent.	Less than 99° Per cent
After four hours	"500"	2·0	2·0	6·2	16·6	33·3	33·3
	"750"	—	2·7	5·4	21·9	31·5	34·2
After seventeen hours	"500"	2·0	4·0	12·5	18·7	25·0	27·0
	"750"	—	—	4·1	12·3	34·2	48·0
After twenty-seven hours	"500"	—	—	—	18·7	43·7	37·5
	"750"	—	—	—	9·6	34·2	54·8

It will be noted that the febrile reaction was greater after the 500-million vaccine than after the stronger one. Small-pox vaccination may have caused this, for 35 out of 48 men who received the 500 dose had been vaccinated within five days of the inoculation. More than half—viz., 52 out of 73—getting 750 millions had been vaccinated seven days at least before inoculation.

On the whole the general reactions were not more severe than those observed when one cubic centimetre of typhoid vaccine was given in August and October, 1914.

In consideration of the fact that nearly all of these men were suffering in some degree from the effects of small-pox vaccination, in all probability the reaction following a one cubic centimetre dose of the mixed vaccine would, under normal circumstances nowadays, be less severe than that produced by one cubic centimetre of the anti-typhoid vaccine as prepared before the War.

Group B.

Reaction following Inoculation with a Mixed Vaccine.—B. typhosus 1,000 million per cubic centimetre; *B. paratyphosus* A, 500 million per cubic centimetre; *B. paratyphosus* B, 500 million per cubic centimetre (all prepared from agar cultures).

On December 19, 1915, twelve recruits of the R.A.M.C. were inoculated with the above vaccine. The dose was one cubic centimetre, and was given at 2 p.m. The men were seen at 6 p.m. The signs of local reaction were slight, and only four had temperatures above normal, the highest being 99·6° F.

They were seen again at 9 a.m. on the following morning when the local reaction was still slight, and four had temperatures above normal, of which the highest was 99° F.

At 6 p.m. on the 20th, the temperatures were higher, six being above normal (two men absent), and the highest was 101° F. The local reaction had increased, but did not appear to be greater than

that commonly seen after a 0·5 cubic centimetre dose of the ordinary anti-typhoid vaccine. The men were fairly cheerful.

At 6 p.m. on the 21st (fifty-two hours after inoculation) they were still slightly affected. The temperatures of five men were still slightly raised. They did not appear to be troubled much by their arms. The general reaction following the use of this vaccine was distinctly less than that following a similar dose of a broth vaccine, but somewhat delayed in its development, reaching its maximum intensity more than twenty-four hours after inoculation. The local reaction was very markedly less than after a broth vaccine.

The following table shows the percentage of temperatures at various periods after inoculation.

Temperatures upwards of	101° Per cent.	100° Per cent.	99° Per cent.	Less than 99° Per cent.
After four hours	—	—	33·3	66·6
After nineteen hours	—	—	8·3	91·6
After twenty-eight hours	10·0	30·0	10·0	50·0
After fifty-two hours	—	8·3	33·3	58·3

Group D.

The reactions in Group D were noted in a small group of individuals inoculated at the Royal Army Medical College. In this group some individuals had been inoculated previously and some had not. In most cases the temperatures were not obtainable. The results are, therefore, given separately.

No. 1.—Inoculated with anti-typhoid vaccine given in three doses fourteen months previously. First dose: 0·5 cubic centimetre (*B. typhosus*, 1,000 million per cubic centimetre; *B. paratyphosus* A, 500 million per cubic centimetre; *B. paratyphosus* B, 500 million per cubic centimetre). General reaction: Slight headache on the following day. Local reaction: Rapid onset; moderately severe, but very local, lasting sixty hours. Second dose: One cubic centimetre of the same vaccine. General reaction: Slight malaise on the following day. Local reaction: Sharp localized reaction lasting forty-eight hours.

No. 2.—Inoculated with typhoid vaccine eighteen months previously. First dose: 0·5 cubic centimetre of the above vaccine. General reaction: Malaise and headache on the following day. Local reaction: Moderate, lasting three days. Second dose: One cubic centimetre. General reaction: Negligible. Local reaction: The same as after the first dose.

No. 3.—Not previously inoculated. General reaction: Severe. On the same evening as the injection headache and nausea were

felt. His temperature on the following morning was 101·4° F. (sixteen hours after inoculation), and he looked ill, although he said that he felt much better than he had done on the night before. He was not fit for work for two days. Local reaction: This was not severe. Second dose: One cubic centimetre. General reaction: Headache on the following day. Local reaction: Mild.

No 4.—Not previously inoculated. First dose: 0·5 cubic centimetre. General reaction: Slight malaise on the same night. Local reaction: Mild. Second dose: one cubic centimetre. General reaction: mild. Local reaction: mild.

No 5.—Inoculated with anti-typhoid vaccine seven months previously, which inoculation was followed by a very severe reaction. First dose: 0·5 cubic centimetre. General reaction: None. Local reaction: Moderately severe. Second dose: one cubic centimetre. No record was obtained of the reaction after the second dose.

No. 6.—Not previously inoculated. First dose: 0·5 cubic centimetre. General reaction: Severe, though not so bad as the reaction following the second dose which is described below. Local reaction: Moderately severe. Second dose: One cubic centimetre. General reaction: Severe. On the day following the inoculation headache was present though not severe, with a feeling of general malaise. Temperature in the afternoon was 101·5° F. On the following day the constitutional symptoms were less severe. He returned to duty on the following day. Local reaction: Moderately severe.

In none of these cases was the reaction observed more marked than that previously seen after anti-typhoid inoculation, though the quicker onset of symptoms was noticeable, as it was in the case of men inoculated at Aldershot.

Of nineteen men inoculated with a double dose of this vaccine at Mile End Military Hospital none had severe reactions. Captain Lanyon Owen, R.A.M.C., reporting on them, states that in his opinion the reactions were distinctly less than after inoculation with anti-typhoid vaccine as used previously.

Captain Andrewes, R.A.M.C., reported on eleven men who were inoculated at the 1st London General Hospital that the local reaction was in no way excessive, and that the highest temperature noted after inoculation was 101·8° F.

Group E.

Ninety men of the Royal Army Medical Corps at Aldershot were inoculated as follows:—

On November 25, 0·5 cubic centimetre of a vaccine containing

B. typhosus 1,000 million, *B. paratyphosus* A 750 million, and *B. paratyphosus* B 750 million, in one cubic centimetre.

On December 6, 1·0 cubic centimetre of the same vaccine.

The men were seen and temperatures taken in the evening, five to six hours, after inoculation, and again on the following morning, seventeen hours after.

The reaction, both local and general, was mild. In one case only did the temperature on the first evening reach 102° F., and this man was found to have been suffering from a slight influenzal attack. After the second dose the febrile reaction was decidedly less, and the local reaction, on the whole, greater than after the first. In this respect the mixed vaccine appears to differ from the simple anti-typhoid vaccine in the case of which it is more usual to have a greater local reaction after the first dose.

It will be noted in the subjoined table of temperatures that the rise after the second dose occurred somewhat later than after the first dose.

	First dose		Second dose	
Temperature	Evening	Morning	Evening	Morning
102°	1	—	—	—
101°	1	—	—	—
100°	15	6	—	5
99°	15	8	12	39
Below 99°	58	76	74	42

The addition of 750 millions each of *B. paratyphosus* A and B to each cubic centimetre of vaccine does not appear to have made any noteworthy increase in the reaction.

Antibody Production.

In the several groups the agglutinin production was estimated at three different periods—ten days after the completion of inoculation, that is, ten days after the single dose in the case of Groups A, B, and C, and ten days after the second dose in the case of Groups D and E. This was repeated three weeks and six weeks after inoculation. The end-point of agglutination was determined by arranging the specimens of blood from each group in batches of five or six and pooling the sera of each batch.

The results obtained from these batches were very consistent, but where any variation occurred an average of the end-points of the batches was struck and that taken as the end-point for the group. The number of bloods examined at the later periods from each group varied as the men changed stations or were sent overseas.

In Group D we were able in some cases to estimate the opsonin production as well as the agglutinins produced.

The antibody production was first estimated in this group, and the two seemed to follow each other so closely that for purposes of comparison between the groups the opsonin estimation was afterwards dropped.

The method of estimating the agglutinin production was as follows: The agglutinin content of the blood was estimated twenty-four hours after the blood had been drawn off. The emulsion used consisted of a saline emulsion of a twenty-four hour culture, standardized to contain 2,000 million organisms per cubic centimetre, and was used in the living condition. The mixture of diluted serum and emulsion was drawn well up into the shoulder of a capillary tube, placed in the 37° C. incubator for two hours, and the result was finally read at the end of twenty-four hours.

With reference to the above we should like to point out how important it is that such information should be given, as in many recent papers, especially those dealing with the agglutinin production in the enteric group, the method of estimating the end-point is not stated. Owing to the greatly divergent results obtained by various observers, probably on account of the use of different methods of estimation, unless the method used is stated the figures given in any particular case lose a great deal of their value.

The groups correspond to those referred to under the report on reactions observed after inoculations.

Group A.—The number of men comprising this group was ten. Their bloods were divided into two batches of five each. Equal quantities of sera from each of the bloods in the batch were mixed and the end-point of the sera estimated. The average titre of the two batches was then struck. This procedure was carried out with each group. Ten days after the single dose of one cubic centimetre the end-point for *B. typhosus* was reached in a dilution of 1 in 20. This at the end of three weeks had risen to 1 in 300, and at the end of six weeks was found in a dilution of 1 in 200. In the case of *B. paratyphosus* A, the end-point was reached after ten days in a dilution of 1 in 120, after three weeks in 1 in 50, and after six weeks in a dilution of 1 in 20. The end-point for *B. paratyphosus* B after ten days was observed in a dilution of 1 in 200. After three weeks this had fallen to 1 in 100, at which point it still remained after an interval of six weeks.

Group B.—The number of men in this group was twelve. Their bloods were divided into two groups of six each. Taking

the agglutinin production against *B. typhosus* first, a much quicker rise was noticed than in the case where a broth vaccine was used. However, after three weeks, the end-points were standing at the same level. At the end of ten days the titre of these sera with *B. typhosus* was 1 in 400 ; at the end of three weeks 1 in 300, and at the end of six weeks 1 in 200, the same as in the case of Groups A and C. With *B. paratyphosus* A the end-point of agglutination after a period of ten days was reached in a dilution of 1 in 100, and it was still found to be at this level at the end of three weeks. After six weeks it stood at 1 in 80. This apparent discrepancy with Group A which received exactly the same dose may possibly be due to the fact that at this period very few men were available from whom we could obtain sera. The end-points for *B. paratyphosus* B after the three intervals were found to be 1 in 200, 1 in 100, and 1 in 80.

Group C.—Eleven men were included in this group. The bloods were divided into two batches of five and six. The antibody production for *B. typhosus* showed a slow rise, as in the case of Group A. After ten days the end-point was reached in a dilution of 1 in 40; which rose to 1 in 300 at the end of three weeks, and had dropped again to 1 in 200 by the end of the sixth week after inoculation. The agglutinins for *B. paratyphosus* A were not produced to quite the same extent as in the case of the men who had a single dose of the vaccine containing 500 millions of the organism. The end-point was reached in a dilution of 1 in 100 at the end of ten days, but the titre of the two groups was so close that the difference might well have been merely an experimental error. After three weeks' interval the titre was distinctly higher than the case of Group A, the end-point being in a dilution of 1 in 100. This had, however, fallen to 1 in 40 by the end of the sixth week. The titre of the serum for *B. paratyphosus* B at the end of ten days was the same as that for Groups A and B, but by the end of the third week it had kept to a higher level, the end-point being in a dilution of 1 in 150. It still remained at this point at the end of the sixth week.

Group D.—In this group we were able to estimate the opsonin production of some of the sera as well as the agglutinin elaboration. The average agglutination titre for *B. typhosus* ten days after the second dose was 1 in 485, after three weeks 1 in 500, and it still remained at this height six weeks after inoculation. The titre for *B. paratyphosus* A after ten days was not any higher than those obtained after a single dose of the same vaccine, the

end-point being reached in a dilution of 1 in 100; after the period of three weeks the titre was 1 in 50, the same as in the case of the single dose of one cubic centimetre, but at the end of six weeks with

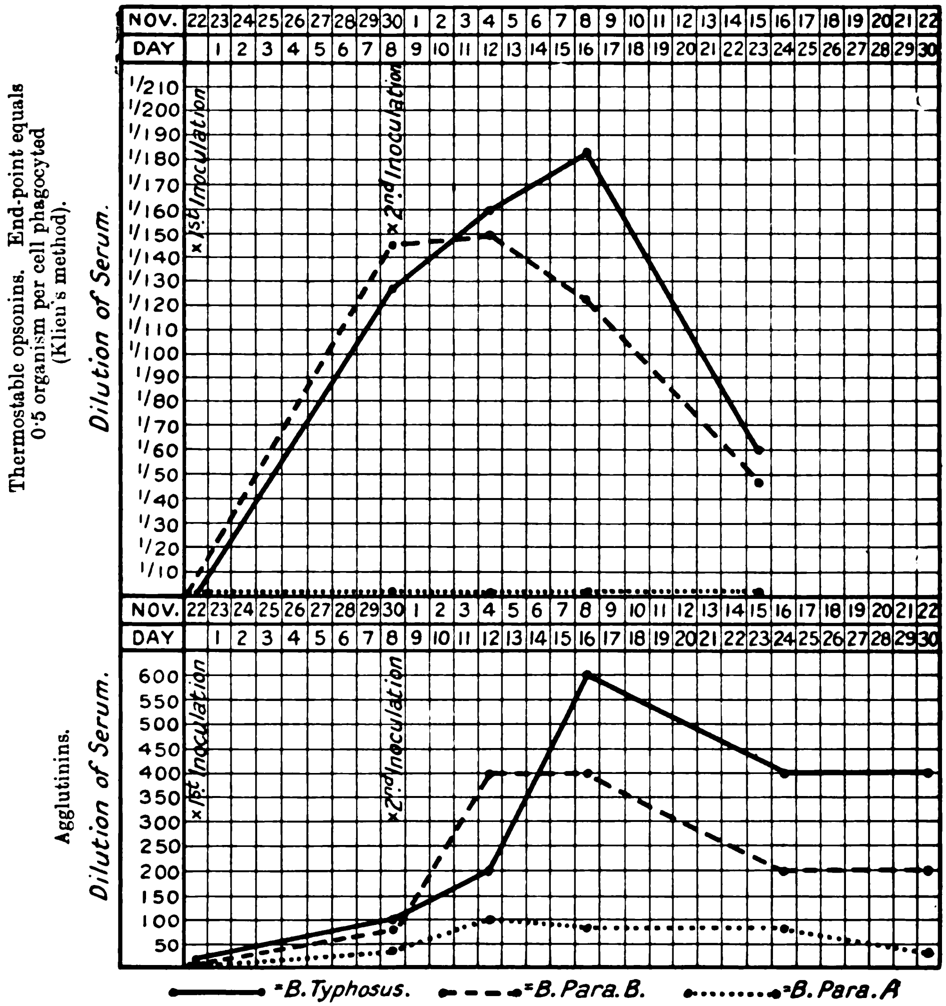

Chart I.—The above represent the agglutinin and thermostable opsonin curves of a man in Group D receiving two doses of a vaccine containing 1,000 million *B. typhosus*, 500 million Para. A, and 500 million Para. B per cubic centimetre. The opsonin content of the serum for *B. paratyphosus* A is shown along the base-line as the end-point was never demonstrable in a higher dilution than 1—9, which is no better than some of the normal controls. *This man had very little reaction.*

a titre of 1 in 40 it had remained above that of the single-dose men. The advantage of the two doses is more marked in the case of *B. paratyphosus* B than in that of *B. paratyphosus* A. After ten

days the titre was almost double that of the single-dose sera, the end-point being reached in a dilution of 1 in 350. It fell to 1 in 200 after three weeks and at the end of six weeks was still maintaining this level.

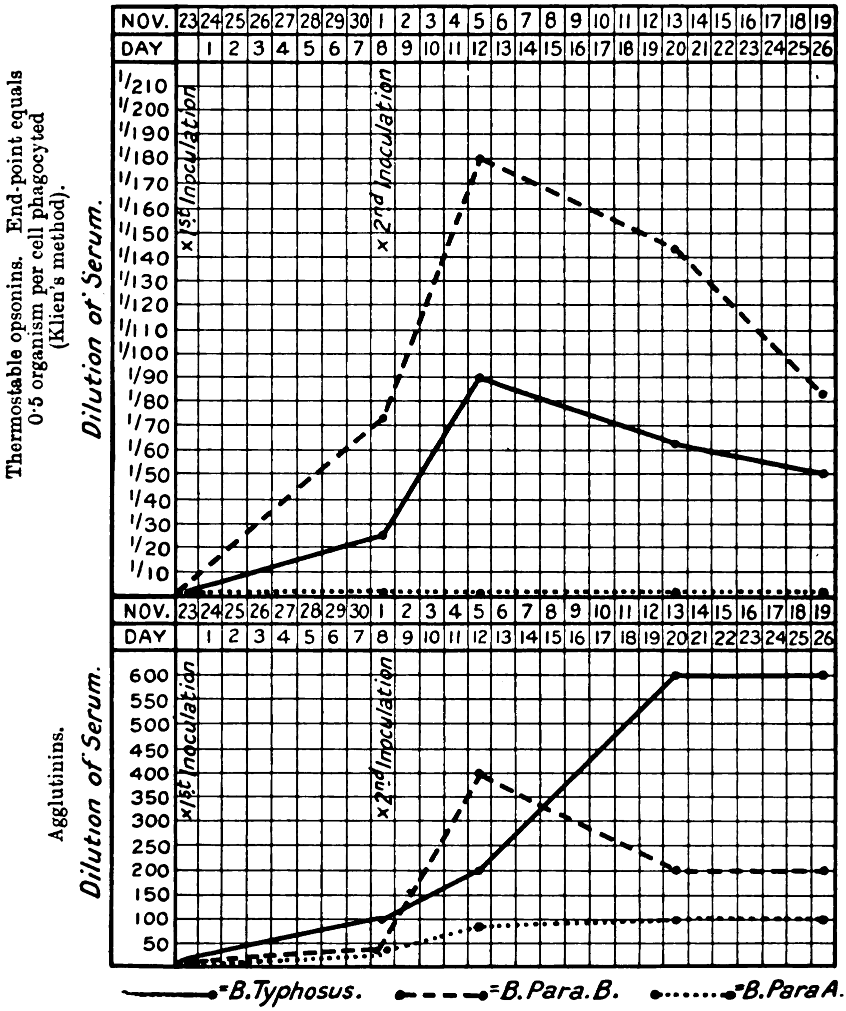

CHART II.—The above represents the agglutinin and thermostable opsonin curves of a man in Group D receiving two doses of a vaccine containing 1,000 million *B. typhosus*, 500 million Para. A, and 500 million Para. B per cubic centimetre. The opsonin content of the serum gave the same result as in the case of Chart I. *This man had a severe reaction after the first dose.* This was apparently due to the *B. typhosus* part of the vaccine, and is reflected in the opsonin curve.

We publish two charts showing the agglutinin and thermostable opsonin curves side by side of two men inoculated

with two doses of the vaccine used in this group. Chart I is that of a man who had no reaction to speak of either after the first or second doses, while Chart II is the chart of the man No. 3, Group D, under the report on the reactions observed. It will be seen that this man had a sharp reaction after the first dose of the vaccine, and this is reflected in the slow rise of his opsonins for *B. typhosus* which never did at any time rise to the same level as the opsonins of other men in this group whose sera were tested. After his second dose a sudden rise of agglutinins took place, those for *B. typhosus* rising to a titre of 1 in 600 at which level they were maintained for some time. The opsonin production for *B. paratyphosus* B reached a much higher level, the end-point of 0·5 organism per cell being reached in a dilution of 1 in 180. In Chart I a much quicker rise of opsonins for *B. typhosus* is seen, which ultimately reached an end-point of 1 in 182.

The difference between the charts of these two men is interesting. It will also be noted that in neither case was any opsonin produced for *B. paratyphosus* A. This result was borne out in other sera examined from this group, in none of which were thermostable opsonins demonstrable in amount that exceeded 0·5 organism per cell in a dilution of serum of 1 in 9.

The opsonin production in this series of experiments was estimated after heating the serum for half an hour at 55° C. The emulsion used was a twenty-four-hour culture on agar emulsified in normal saline and standardized to contain 1,000 million organisms per cubic centimetre. The mixture of serum, blood cells, and emulsion was then placed in a water-bath for fifteen minutes. Klien's method of estimating the end-point was used, taking 0·5 organism phagocyted per cell as standard. The average heights to which the opsonin production rose for this group of men were as follows:—

For *B. typhosus:* End-point 0·5 per cell in dilution of 1 in 157.
For *B. paratyphosus* B: End-point 0·5 per cell in dilution of 1 in 166.

In the case of *B. paratyphosus* A we were never able to get the end-point in a higher dilution than 1 in 9, in which dilution normal bloods were found by us to possess thermostable opsonins for *B. paratyphosus* A.

Group E.—The bloods of thirty-six inoculated men were examined in this group, and were arranged in six batches. It will be seen by looking at Chart III that taken all round a higher titre was produced for all three organisms than in any other group

AGGLUTININS.

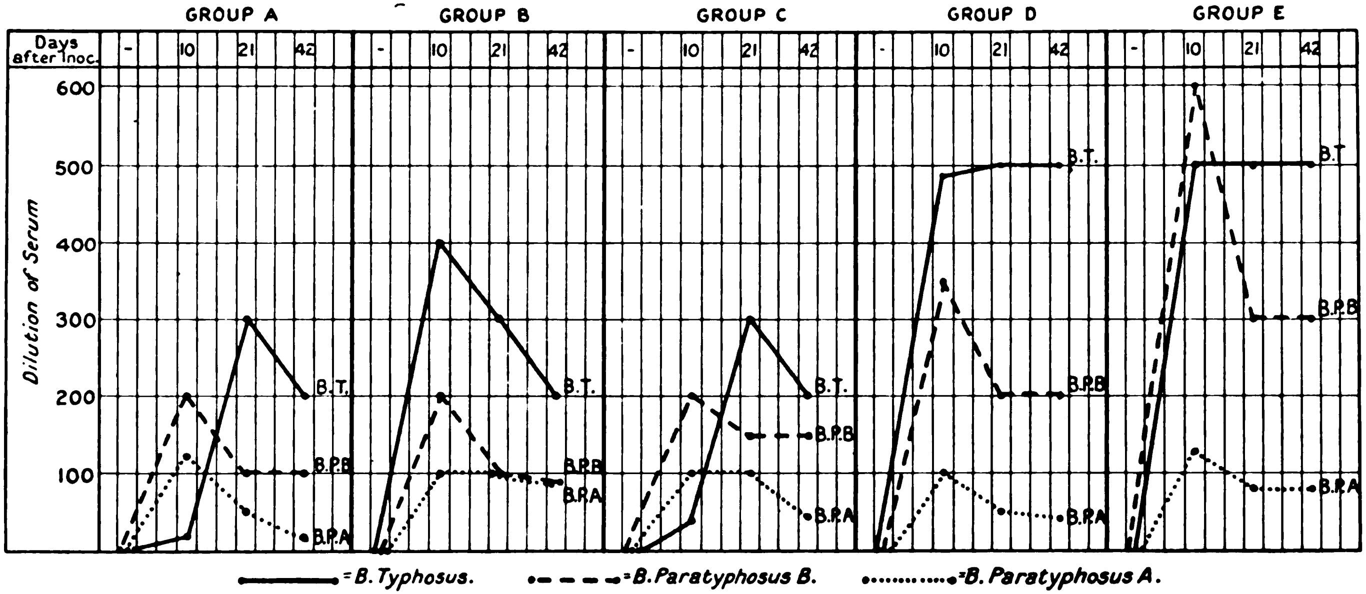

CHART III.—The interval of 10, 21, and 42 days indicates the number of days after the single dose of 1 c.c. of the vaccine in the case of Groups A, B and C, in the case of Groups D and E the number of days after the second dose of vaccine. For the doses received by the different groups see the first paragraphs of this paper.

in which we estimated agglutinin productions. The end-point for *B. typhosus* ten days after the second inoculation was reached in a dilution of 1 in 500, and it still remained at this titre after an interval of six weeks. The agglutinin production for *B. paratyphosus* A, which at first was not increased in amount above any other group, remained very much about the same in amount up to the end of the sixth week. In the case of *B. paratyphosus* B the agglutination titre shot up in a very marked way ten days after inoculation, fell after three weeks to a titre of 1 in 300, and remained at that figure until after the end of the sixth week. The vaccine used for men comprising this group is that which is now being issued for the inoculation of the troops.

We should have liked to have followed up these men for a still longer period, but they were gradually lost sight of.

Controls were done with the same strains of organisms. The *B. typhosus* vaccine given by itself produced an agglutination titre of 1 in 400 a month after inoculation. Mixed *B. paratyphosus* A and B vaccine gave titres for *B. paratyphosus* B of 1 in 200 at the end of three weeks, and 1 in 40 for *B. paratyphosus* A. The end-point for opsonins with this vaccine for *B. paratyphosus* B was in a dilution of 1 in 150, and for *B. paratyphosus* A again nothing could be obtained above a dilution of 1 in 9.

We lately had the opportunity of examining the serum of a man inoculated ten weeks previously with a vaccine containing 3,000 million *V. choleræ*, and 500 million each of *B. paratyphosus* A and B. His serum showed agglutinins for *B. paratyphosus* B to be present in a dilution of 1 in 150, but no agglutinins for *B. paratyphosus* A could be obtained. Eight days after his second dose of vaccine he had shown an agglutination titre of 1 in 200 for *B. paratyphosus* B, with a high thermostable opsonin end-point of 1 in 244 dilution of serum. On the other hand, at the same period the agglutination titre for *B. paratyphosus* A had been 1 in 80, with no rise of thermostable opsonins.

Conclusions.

In summing up it is best to consider the reports on the reactions and the antibody produced together.

It is obvious that the dose of all three organisms should be kept as high as possible without the reactions becoming excessive. Small doses of a vaccine do not produce as good antibodies as large doses, and therefore one may reasonably expect that the immunity conferred is less in the case of the small doses without there being any

direct relation between the two. In this series of experiments the most severe reactions taken all round were experienced among the men comprised in Groups A and C, that is, among men who received a single dose of one cubic centimetre of a vaccine containing a broth culture of *B. typhosus*, diluted to a strength of 1,000 million, and *B. paratyphosus* A and B, of each in the case of Group A 500 million, and in the case of Group C 750 million.

In conjunction with this marked reaction we see a slow rise in the antibody production against *B. typhosus*. In the case of men in Group B, in which an agar vaccine of *B. typhosus* was used, a much quicker rise in the antibody elaboration goes hand in hand with a less marked, though longer delayed reaction.

This discrepancy between the agar and broth *B. typhosus* vaccine is lost sight of by the end of the third week, after which the titres of the two sera were found to stand at the same level.

We were unfortunate in losing sight of the men inoculated with the agar vaccine so soon, as we have always thought that protection afforded by a broth vaccine lasts longer than that produced by the same organism grown on agar. We think that this may be explained by the fact that an organism grown in broth is more liable to autolysis than if grown on agar. On account of this autolysis, the dose of a broth vaccine is really higher than that estimated, while at the same time it necessarily becomes more toxic.

In the case of *B. paratyphosus* A there is very little to choose between a single dose of one cubic centimetre containing 500 million and a single dose of the vaccine containing 750 million, as at the end of six weeks the titre of the first is 1 in 20 and that of the second 1 in 40. The effect of the larger dose is slightly more marked in the case of *B. paratyphosus* B.

Turning to the results with the double doses of 0·5 and one cubic centimetre of the vaccines containing the two strengths of the paratyphoid bacilli, the reactions were not more marked than in the case of the old antityphoid vaccine, and very much less marked than in the case of the single doses of the mixed vaccine.

On the other hand, much more agglutinin was produced, and in this case the administration of the larger doses of *B. paratyphosus* A and B produced a higher titre for A and B at the end of six weeks than did the smaller dose. In the case of *B. typhosus*, of course, the same dose was given in each case, and the titre of sera was identical.

Another curious fact which has come to light in the course of

these experiments is that whereas in rabbits we found that *B. paratyphosus* A in the vaccine produced more agglutinin in the sera than did *B. typhosus* or *B. paratyphosus* B, yet we could not demonstrate thermostable opsonins for this organism any more than we could in the case of man (the same strains being used in each case). From these experiments the following conclusions may be drawn :—

(1) That the highest dosage used is the best for producing lasting antibodies against these three organisms, and that the vaccine should be given in two doses rather than in one, both on account of the reaction produced by the single dose of one cubic centimetre, and also on account of the higher antibody content produced when the two doses are given.

(2) The want of antibody production for *B. paratyphosus* A is a very strong feature of these experiments when compared with those elaborated for *B. typhosus* and *B. paratyphosus* B. As to the immunity produced against this organism, that can only be decided by actual trial, but the results obtained in the course of these experiments seem to point to the fact that the *B. paratyphosus* A content of the vaccine may not achieve its object to the same extent as that of *B. typhosus* and *B. paratyphosus* B.

Our thanks are due to Lieutenant-Colonel D. Harvey, R.A.M.C., for his assistance in the carrying out of some of the experiments and in the compilation of the paper.

THE TREATMENT OF GUNSHOT INJURIES OF THE JAWS.

By J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S.

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In the following paper it is proposed to describe briefly the methods adopted and the experience gained in the treatment of cases of gunshot injuries of the jaws in the Croydon War Hospital. At the outset it may be of interest to state that the Croydon War Hospital is a special hospital under the Eastern Command, and has been formed with the view of collecting in groups certain types of cases; at present the groups included are cases of (1) injuries of the nerves; (2) injuries of the joints, resulting in "stiff joints"; (3) injuries of the ears; (4) injuries of the jaws. The Hospital consists of five blocks scattered over the district of Croydon, the total number of beds being about one thousand. The cases of injuries of the jaws are in Division V, situated in Stanford Road, Norbury. This Division contains 166 beds and is to be entirely devoted to jaw cases. The Hospital has been open just over six months and during this period[1] 204 cases have been under treatment, and of these 96 have been admitted since December 1. The majority of cases admitted so far have already been under treatment and come under the category of united fractures.

Gunshot wounds of the jaws differ materially in their character from the ordinary fractures met with in civilian practice, and in the present War this is more especially the case owing to the high velocity of the bullet and the highly explosive character of the shells and bombs. The problems facing one in the treatment of the injuries are to a great extent fresh ones, and the treatment cannot altogether be carried out on the ideal lines suggested by those who have written on this subject, drawing their experience from civilian life. In treating these injuries the surgeon is perhaps too apt to lose sight of the utility of interdental splints, while the dental surgeon is too apt to lose sight of the facts that treatment is required beyond the mere adaptation of splints, and that the too early adaptation of a splint, by adding to the sepsis, may just alter the balance between life and death.

[1] To the end of February.

The first aim in all severe cases should be directed towards saving the life of the patient, and not until this is ensured should splints be adapted or surgical measures, such as wiring, carried out. The next step should be directed towards ensuring union of the jaw; if this can be carried out by restoring the contour of the jaw and occlusion, all the better, but, if, by endeavouring to restore the contour of the jaw and occlusion, a risk is run of obtaining non-union, then the ideal should give way to the practical, for it is far better for an individual to have a firm mandible and a moderate amount of malocclusion than an ideal-shaped bone which is unable to bear the strain of mastication. The masticating surface in a mandible with mal-union can often be easily rendered efficient by artificial dentures.

The general routine of treatment is as follows: On admission, brief notes are taken and the mouths cleansed either by mouth-washes or frequent syringing with peroxide of hydrogen, and once a day the gums are swabbed with a two per cent solution of iodine in alcohol. Skiagrams are obtained and models of the mouth taken. The next step is to anæsthetize the patient and examine the character of the injury and see how far reduction of the fracture is possible. The necessary septic teeth are removed as well as the teeth bordering on the line of fracture; the importance of this latter step I shall refer to subsequently. Any sinuses present are also examined and treated, but no attempt is made to remove necrosed bone unless it has sequestrated. The necessary splints are made and adjusted if needful under an anæsthetic. When healing of the bone is complete, the splints are removed and a simple retention splint inserted, and the patient may be said to have reached the convalescent stage.

If the man is immediately returned to his depot he will find himself unable to cope with ordinary food and will therefore go "sick." To avoid this and gradually accustom him to acquire the power to bear the brunt of efficient mastication, he is taken through a graduated course of diet. In civilian practice the construction of such a series of diets is easy, but in military life it has to be drawn up from the variety of foods coming within the limits of Army regulations. Captain H. M. Holt, Officer-in-Charge, has suggested four diets as follows:—

(*a*) Fluids; (*b*) minced; (*c*) boiled; and (*d*) ordinary.

(*a*) Milk diet, beef tea, chicken broth, supplemented by "extras" to be ordered when necessary for the treatment of the case (*vide* regulations).

(*b*) Minced chicken, and minced ordinary diet, supplemented with minced fish, eggs, and semi-fluid puddings.

(*c*) Boiled ordinary diet, supplemented by fish, eggs, suet puddings, toast.

(*d*) Ordinary diet in accordance with the regulations.

It is found that patients who have sustained jaw injuries rapidly lose weight; hence the provision of suitable diets becomes a matter of first-rate importance. The patient must be carefully dieted, not only to increase his weight and strength, but also in order that full advantage may be taken of the mechanical advantages of a graduated diet in bringing about increased muscular movements and restoration of the functions of the jaw.

It may be here noted that such movements may be assisted by massage and other mechanical means.

(1) Splints.

The types of splints commonly used are as follows :—

(*a*) *Interdental Wire Splint.*—This form of splint, usually known as the "Hammond," is shown in fig. 1. It consists of a

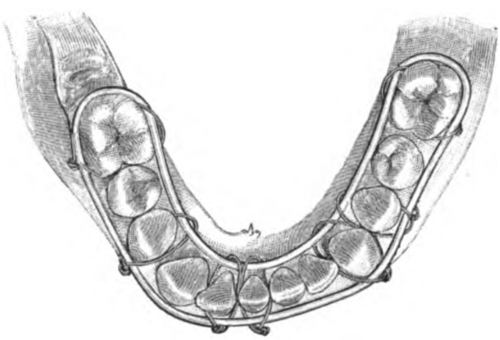

Fig. 1.

(From Colyer's "Dental Surgery and Pathology." By permission of Messrs. Longmans, Green and Co.)

wire fitted closely round the external and internal aspects of the teeth, the individual teeth being wired to the splint. In cases where there is a tendency for the splint to slip towards the gum margin the inner and outer wires may be united by stays running over the occlusal surfaces of the teeth (fig. 2). The interdental wire splint can easily be kept clean and is best employed in cases where there is but little displacement of the fragments.

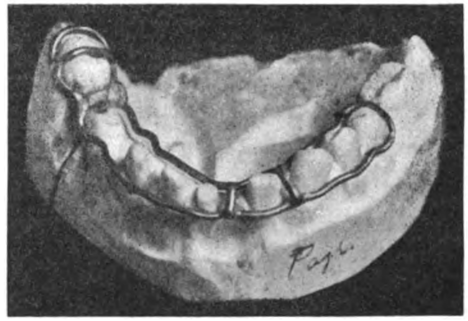

Fig. 2.

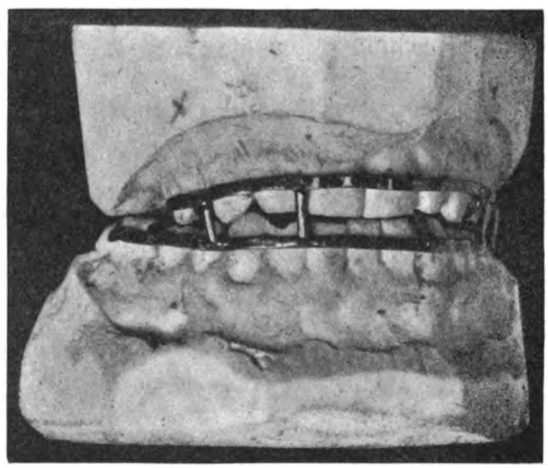

Fig. 3.

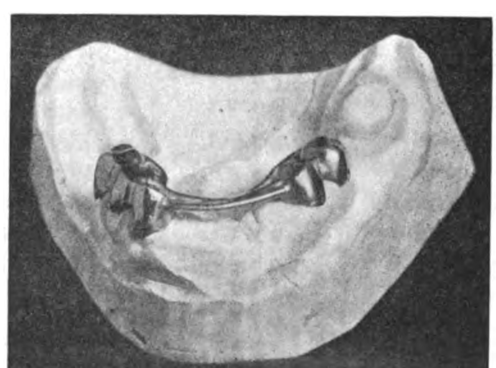

Fig. 4.

Another interdenal wire splint is shown in fig. 3, and is known as Payne's cradle splint. It consists of wire splints for the upper and lower teeth soldered together. This splint is useful in cases where there is a lateral deviation of the mandible.

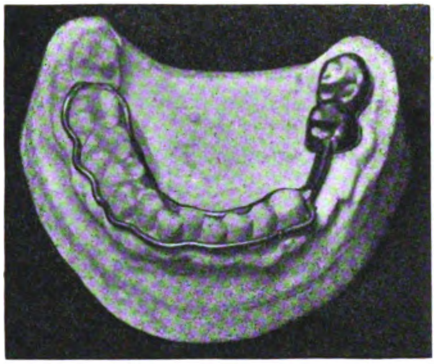

FIG. 5.

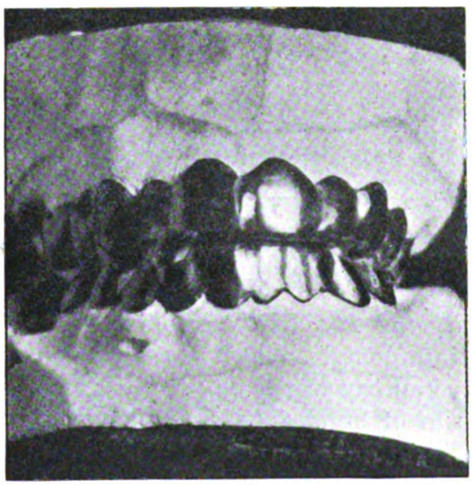

FIG. 6.

(*b*) *The Metal Cap Splint* (Fig. 4).—This is by far the most useful type of splint. It consists of a metal cap or caps made to fit fairly closely to the teeth, and is fixed by means of a cement such as oxyphosphate of zinc or copper. Properly constructed, this will keep the fractured parts absolutely rigid. A combination

of the interdental wire splint and the cap splint is shown in fig. 5.

(c) *The Gunning Splint* is the name given to a splint which embraces both upper and lower teeth. It can be constructed in vulcanite or metal, and finds its best use in cases where there is lateral deviation of the mandible. This type of splint is shown in fig. 6.

(d) *Wiring*.—In this method bands are adjusted to certain teeth in the maxilla and mandible, the bands being united by means of wire ligatures, as shown in fig. 7.

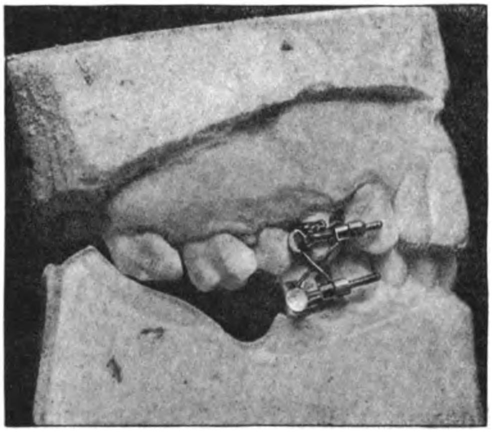

FIG. 7.

(e) *The Skull and Mandibular Splint*.—An extremely useful adjunct to the interdental splint is the apparatus shown in fig. 8. It consists of a skull cap woven out of thick mercerised cotton and bordered by a rim of braid about three-quarters of an inch wide. Two hooks are fitted on each side in front and one behind. The mandibular splint is made from metal and can be fashioned to various shaped mandibles. At the ends the metal is turned over to form catches. The metal cap is connected with the skull portion by cord or tape and according to the pressure exerted one may obtain an upward or a backward pull. This splint is used extensively, as an adjunct to interdental splints, with a view of supporting the mandible and so giving rest and comfort to the patient. Illustrations of this splint are shown in figs. 8 and 9.

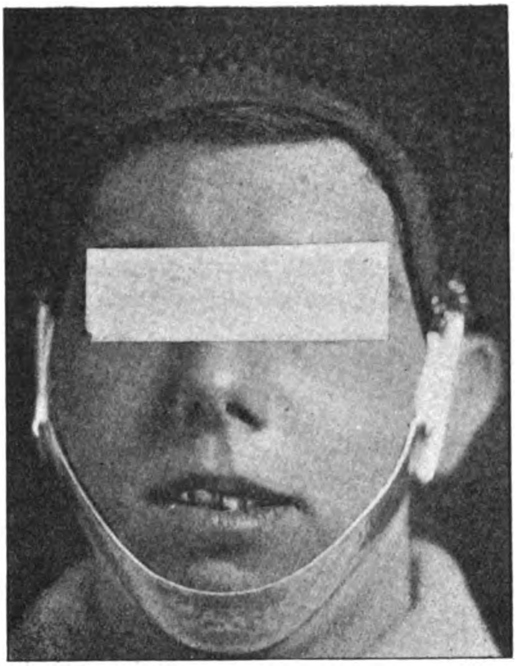

Fig. 8.

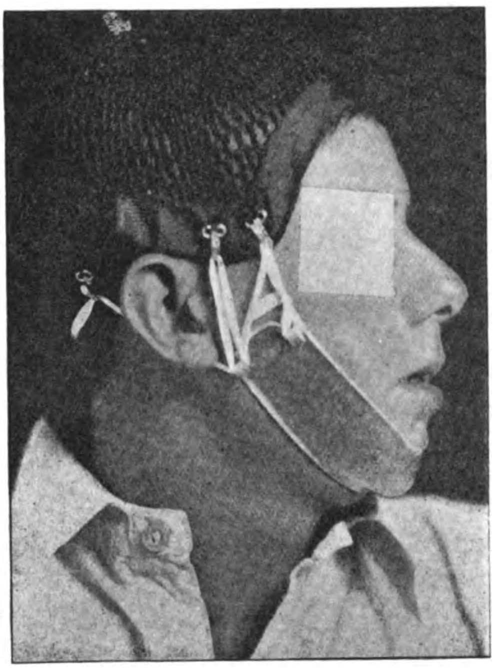

Fig. 9.

(2) The Displacements in Fractures of the Mandible.

The displacements in fractures of the mandible are dependent upon the direction of the force causing the injury, the extent of the injury, and the action of the muscles. Fractures in the region of the molars are accompanied by a depression of the anterior fragment and a swinging over to the affected side, the posterior fragment being usually drawn upwards and inwards. It is to this latter displacement that particular attention is drawn, because a failure to recognize it leads to many complications in treatment, while advantage may be taken of it to assist healing.

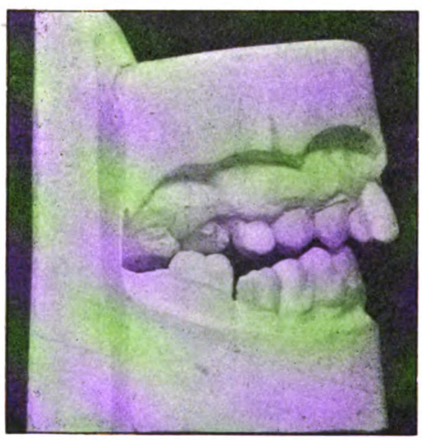

Fig. 10.

In civilian practice the posterior fragment is as stated usually drawn upwards and inwards, but in gunshot injuries the impact of the projectile often forces the anterior fragment inwards, and the posterior fragment moves forwards and passes outside the anterior fragment.

A case illustrating this type of displacement is shown in figs. 10 and 11. This patient was wounded on April 25 last year and was admitted to the Hospital on January 28 of this year with an ununited fracture. The right mandibular first and second molars were missing; the posterior fragment had moved forwards so that the third molar occluded slightly external to the first and second maxillary molars, while the anterior fragment had moved backwards (fig. 10). The malocclusion of the left premolars and

molars are shown in fig. 11. The skiagram (fig. 12)[1] of the patient, taken before treatment, showed a marked space between the fragments with the teeth situated in the line of fracture.

In the majority of cases we have to deal with a loss of tissue and we have the following condition present: the posterior fragment is drawn upwards and meets the opposing teeth and the anterior fragment slews round to the injured side. If the upward resistance to the posterior fragment is removed by the extraction of the posterior teeth, the fragment will move still more upwards,

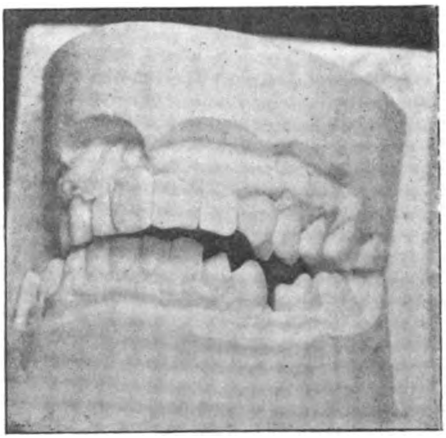

FIG. 11.

but at the same time forwards, and so bridge over the gap of lost tissue. This movement of the posterior fragment is shown in figs. 13 and 14. The recognition and utilization of this forward movement is of great practical importance in obtaining union.

The following case is also instructive:—

Case 1.—This man was injured on July 15 by shrapnel, which fractured the jaw on the right side and carried away the first molar and the premolars. The only teeth present were:—

$$\begin{array}{r|l} 4\ 3 & 3\ 4 \\ \hline 7\quad 3\ 2\ 1 & 1\ 2\ 3\ 4\quad 7 \end{array}$$

When seen on November 1 there was necrosis in the region of the fracture, and owing to the absence of teeth on the right side, the posterior fragment had swung forward so as to bring the second

[1] In reproducing the skiagrams for this paper certain details have been in places emphasized.

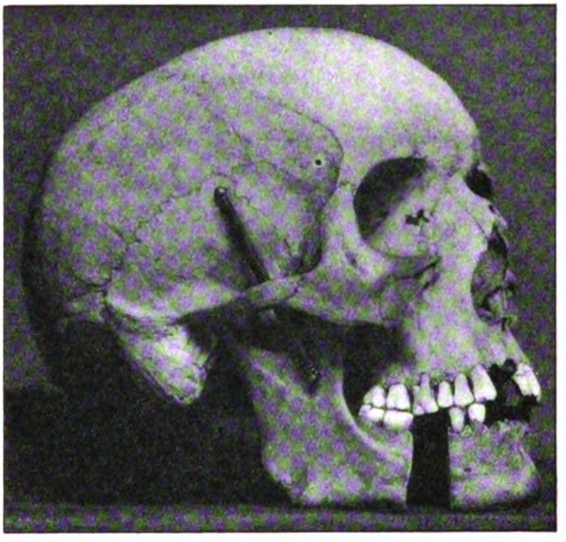

FIG. 13.—A portion of the mandible has been removed to represent lost tissue, but the molar teeth have been retained. The posterior fragment remains in place.

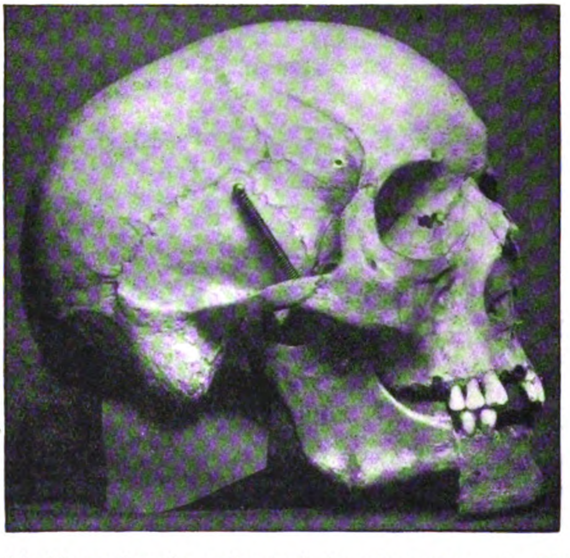

FIG. 14.—In this illustration the molar teeth have been removed. This has allowed the posterior fragment to move forward.

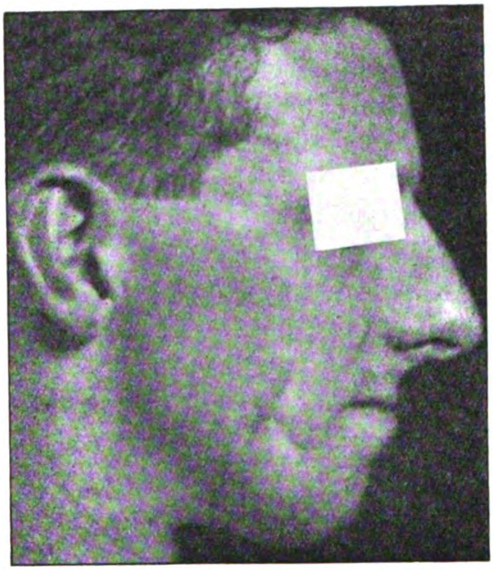

Fig. 15.

Fig. 16.

molar in close proximity to the canine. The anterior fragment was in fair position. The X-ray showed a considerable amount of callus in the region of the fracture; the fragments could be easily moved; there had been no dental treatment. On November 7 a Hammond splint was adjusted, and several pieces of necrosed bone were subsequently exfoliated. On January 20 union was complete and a retention splint was inserted. The left fragment was in good occlusion; the right fragment had swung well forward and so rendered osseous union possible. The delay here was due to not keeping the parts at rest with an interdental splint, and the favourable result in some measure to the natural forward movement of the right fragment owing to the absence of the molar teeth in that side.

The upward and forward movement of the posterior fragment is seen in fig. 15, and shows that the displacement of this fragment does not cause an appreciable deformity. A full face view is shown in fig. 16.

A common type of injury is for the bullet to enter the molar region on the one side and find an exit by the molar region on the other. In such cases we may meet with the following displacement: the posterior fragment on the entrance side is drawn upwards and overlaps the anterior fragment, the latter being drawn well backwards and over to the "impact" side and considerably depressed. On the exit side the posterior fragment is drawn upwards.

The extreme displacement that may be present in this type of injury is shown on fig. 17. This man had been under treatment for over three months before being admitted to the Croydon Hospital. The mandible was fractured on the right side in the region of the first molar; there was a severe fracture on the left side; the right central incisor was in contact with the first molar which was lying horizontally along the margin of the right posterior fragment. The central fragment which was fractured in a horizontal direction was lying across the mouth as shown in the skiagram.

In cases of injury in the incisor region the resulting displacement varies considerably according to the loss of bone. If the loss of bone involves the body of an alveolar process to an equal extent (as shown in the diagram fig. 19), the two halves of the mandible approximate and we have a parrot-like jaw, but there is little, if any, falling inwards of the fragments. In cases where the loss of the base of the jaw is slight compared to the alveolar

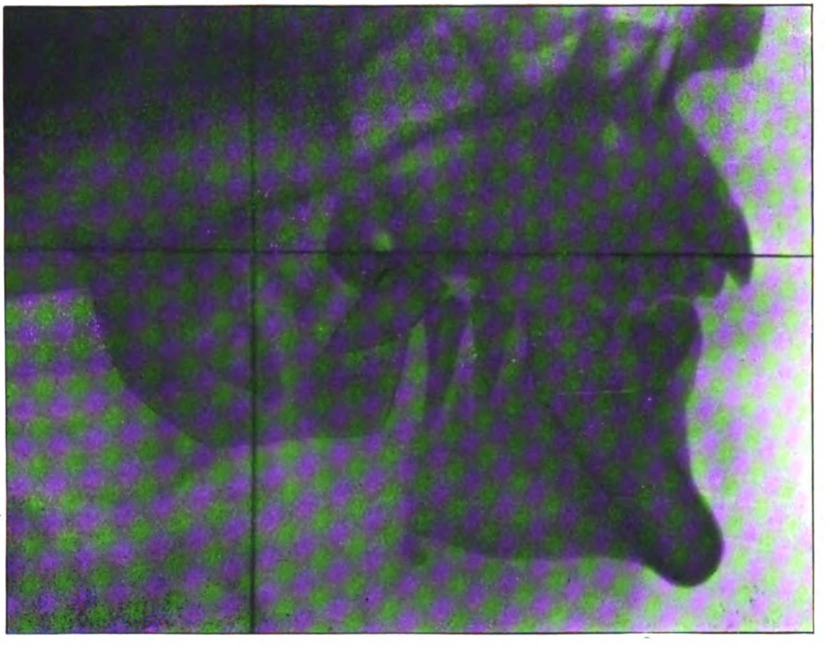

FIG. 12.

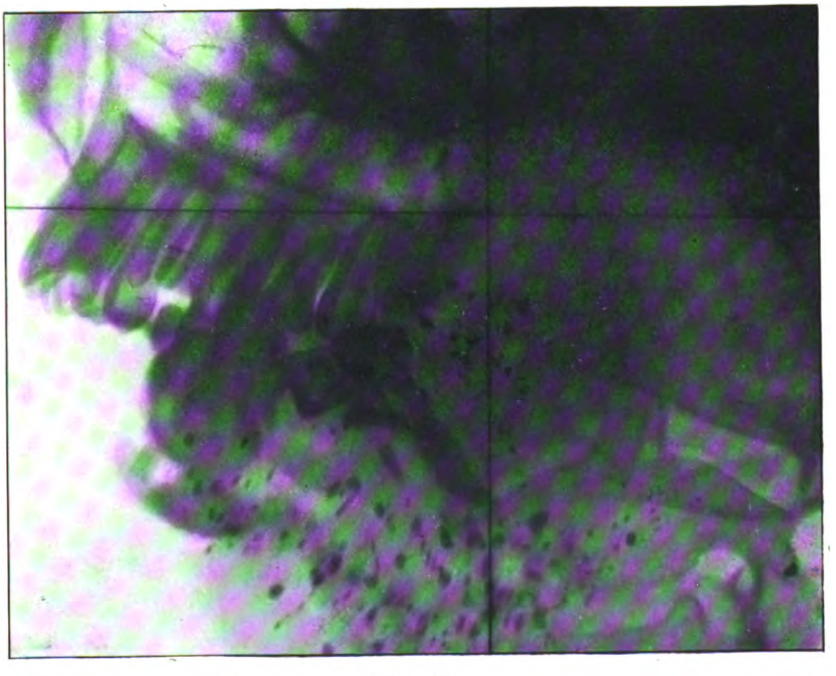

FIG. 17.

To illustrate "The Treatment of Gunshot Injuries of the Jaw,"
by J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S.

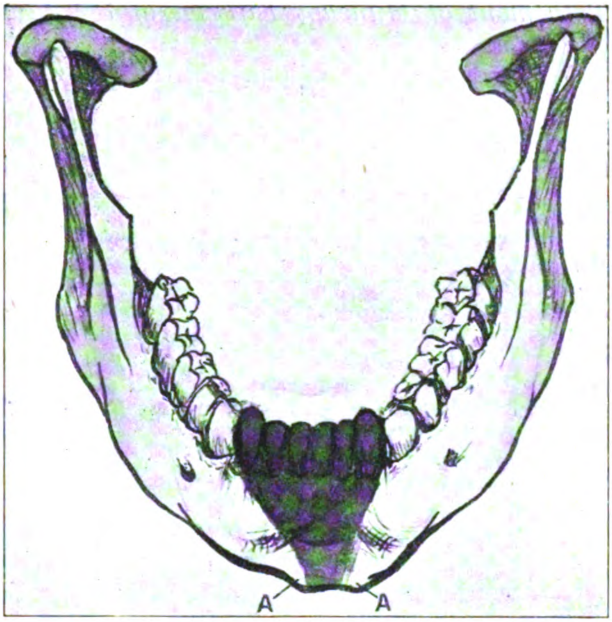

FIG. 18.

I am indebted to Captain H. M. Holt for this and the following diagram.

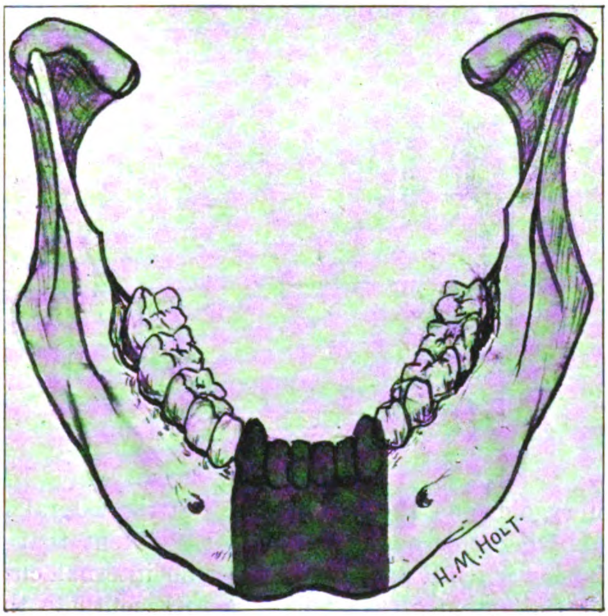

FIG. 19.

process, as shown in the diagram (fig. 18), the following displacement occurs :—

The two halves of the mandible approximate and engage at the lower part marked A, and there is but slight loss of "chin." The

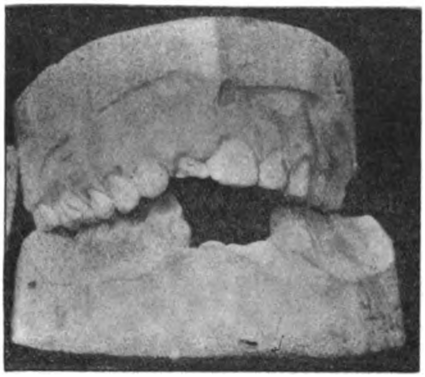

Fig. 20.

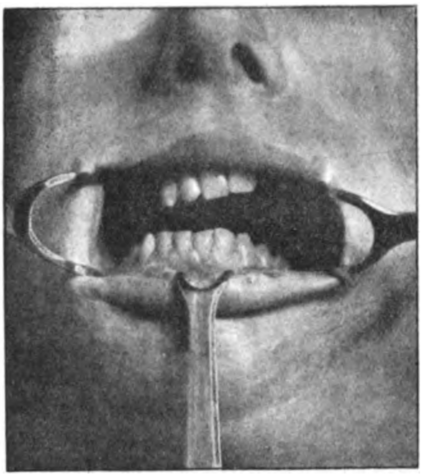

Fig. 21.

external pterygoids and the mylohyoids tilt the lateral fragments inwards, and when this has occurred to the extent that the outer cusps of the lower teeth are internal to the internal cusps of the upper teeth, the action of the "bite" is to accentuate the inward movement of the fragments. This type of deformity is shown in

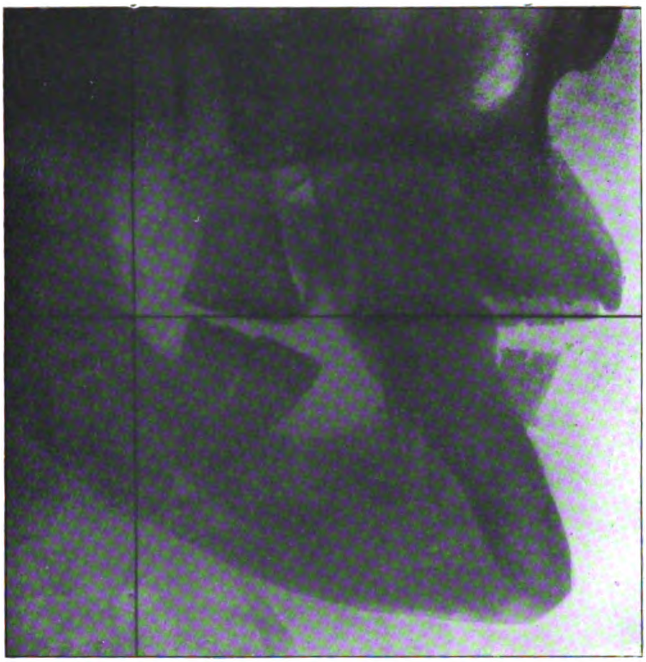

FIG. 22.

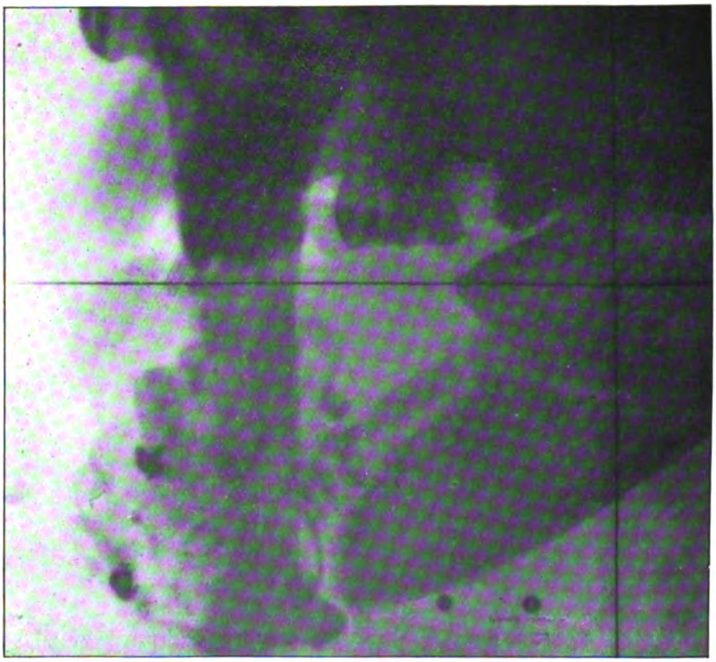

FIG. 23.

To illustrate "The Treatment of Gunshot Injuries of the Jaw,"
by J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S.

FIG. 24.

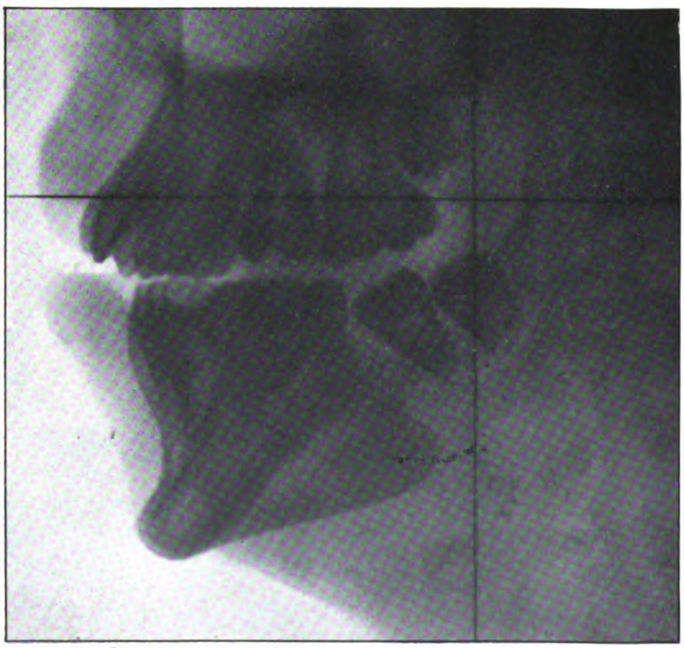

FIG. 25.

To illustrate "The Treatment of Gunshot Injuries of the Jaw," by J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S.

fig. 20. In this man there was but slight loss of bone along the lower border of the bone, but there was extensive loss in the region of the alveolar process. This is a type of deformity that can easily be overcome and avoided by prompt insertion of interdental splints.

Fractures of the ramus are accompanied by a deviation of the mandible to the affected side, accompanied by a marked upward movement, the degree of upward movement corresponding to the loss of tissue (see fig. 21).

When the projectile strikes the bone at right angles the fracture is usually limited to the area of impact, but it does in some cases lead also to horizontal fracture. On the other hand, the glancing shot, although it does not usually lead to much direct loss of tissue, nevertheless causes widespread fractures of the bone, as shown in fig. 22.

In other cases the injury, especially if due to shrapnel, may cause a literal pulverization of the bone, as shown in fig. 23. This man had a severe fracture in the region of the left premolars, a rather worse fracture in the same region on the right side, while the incisors and canines were severed from the body of the bone.

(3) Non-union of Fractures.

A common cause of non-union is the presence in the line of fracture of septic teeth. When a fracture runs between two teeth, the periosteum of the teeth is usually destroyed and a pocket is formed and a stagnation area created. Sepsis follows and union, even under the most favourable conditions, is often delayed, and, even when union of the bone does occur, the pocket remains, and sooner or later leads to loss of the teeth. With this experience before me I have for some years made it a practice to remove the teeth on each side of the fracture. In many of the cases of non-union which have been admitted to the Hospital, the cause has been traced to septic teeth in the fracture, the removal of which has been followed by rapid healing of the fracture. A skiagram of a case of non-union due to the presence of teeth in the line of fracture is shown in fig. 24. The three following cases are an illustration of this point.

Case 2.—This man was hit on May 9, the shot splitting the mandible in the mid-line and carrying away the central and left lateral incisors. The bullet was removed from the floor of the mouth by an incision under the chin. No interdental splints had been used. When seen on November 9 the fragments were freely movable, the mouth was very dirty and there was a sinus

discharging into the mouth from between the right lateral incisor and left canine. The skiagram showed the roots of the teeth in the line of the fracture. This man refused treatment and was not seen again until December 17. The teeth contiguous to the fracture were removed the next day and an external splint applied to be worn during Christmas leave. On January 9 the fragment could only with difficulty be moved; a cap-splint was, however, fixed to ensure absolute rigidity. This was removed on February 12, when union was complete.

Case 3.—This patient was hit on June 20 with a trench mortar; the soft tissues under the mandible were split and the bone was fractured near the mid-line, the central incisors being knocked out. When seen on November 1 the lateral incisors were in contact, the left tooth being fractured; the fragments were freely movable and there was a sinus under the chin. On November 2 the laterals were extracted and a Hammond splint was applied. As the wires were constantly becoming loose, probably owing to the personality of the patient, a metal Gunning splint was fixed on December 12, and by January 18 union was complete.

Case 4.—In this case the bullet entered an inch below and slightly behind the right angle and in finding an exit fractured the bone behind the left first molar. There was no union, there was a sinus under the mandible, and deviation to the left to the extent of an incisor. The man was injured on June 16, and admitted to Croydon at the end of November. The skiagram, fig. 25, showed that the second and third molars were in the area of the fracture; these were removed on November 28, and the sinus was scraped. Bands were adjusted to the left second premolars and ligatured together. On January 18 the jaw had united, but the bands and ligatures were re-applied to overcome the tendency of the mandible to drift to the left side. The skiagram, fig. 26, shows that union has been brought about in a great measure by the swinging forward of the left ramus.

An important cause of non-union is want of rest of the fragments. This is typically seen in fractures about the molar region when interdental splints have not been used. In these cases the tendency is for the posterior fragment to be drawn upwards, and the anterior fragment downwards. When the mandible is at rest the teeth occlude, as shown in fig. 27. When an effort is made to close the teeth the posterior fragment is pushed down, and the whole series of teeth brought into occlusion. The effect is a constant see-saw action of the fragments and therefore non-union

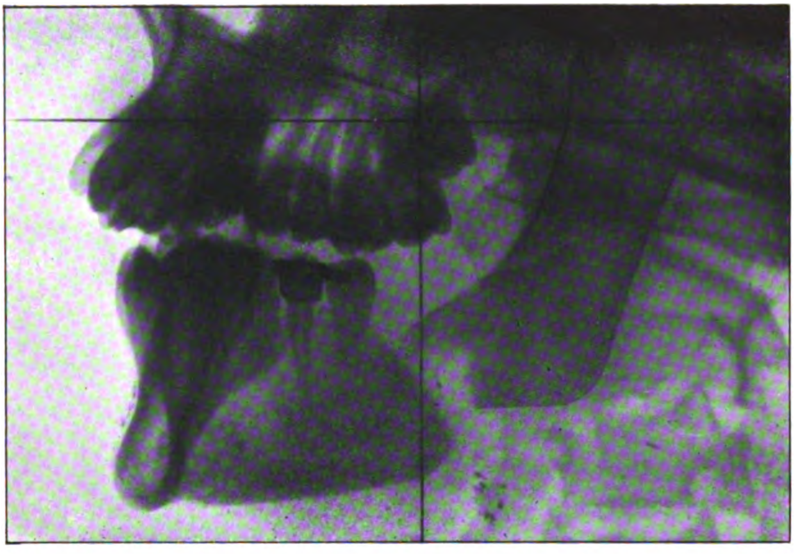

FIG. 26.

FIG. 28.

To illustrate "The Treatment of Gunshot Injuries of the Jaw,"
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In the case shown in fig. 28, the injury occurred on March 22, the first molar being carried away. No dental treatment was considered needful, and the patient arrived at Croydon early in November, with the fragments freely movable. The right maxillary second premolar and molars were removed to give rest to the posterior fragment, and within three weeks the fracture had consolidated so that no movement could be obtained.

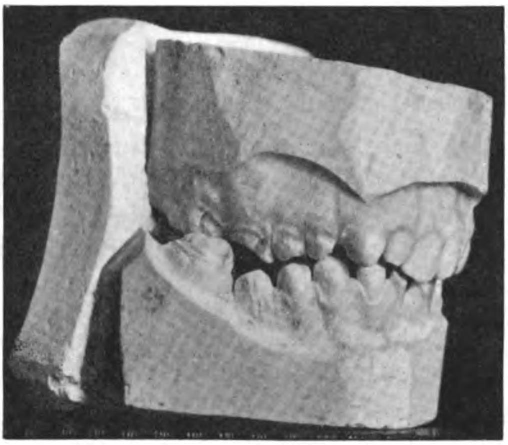


FIG. 27.

(4) UNION WITH A PERSISTENT SINUS.

In a section of the cases which have come under notice the jaw has united but a sinus has persisted. The presence of a septic tooth is the cause in most instances, and with the removal of the tooth the sinus rapidly heals. The following cases illustrate this condition.

Case 5.—In this man there had been a fracture near the right angle of the mandible. The bullet entered the tissues near the left angle of the mouth and hit the mandible on the inner side and from there passed on to the shoulder. He was injured on June 6, and was admitted to the Croydon Hospital towards the end of November. The bone had joined in good position, there having been but slight loss of tissue, but there was a sinus opening about three-quarters of an inch above the lower border of the left ramus. The skiagram, fig. 28, showed the root of a tooth between the fragments near the lower border of the bone. On November 29 this was removed, together with a piece of necrosed bone; by

December 11 the sinus on the face had entirely closed, and by January 1 the wound in the mouth had healed.

Case 6 was seen on September 22. He was injured on May 18 in the mandibular incisor region, the fracture running between the right canine and lateral incisor. The latter tooth had been lost, so that the central incisor was in contact with the canine. There was firm union of the fragments, but a sinus freely discharging pus was present under the chin. A probe passed up the sinus reached the canine tooth. The right canine and both the central incisors were removed. The sinus healed rapidly and recovery was complete by the end of October.

(5) Extensive Fracture in Region of the Angle.

Case 7.—This man was injured in the early part of August in Gallipoli and returned to England from Malta on August 21; he was first seen at the Croydon Hospital on October 22. The bullet entered behind the right external angular process of the orbit and found an exit through the mandible on the left side in the region of the angle. When seen there was an extensive swelling on the left side of the mandible, with a sinus opening below and posterior to the angle. The mandible was deflected over to the left side and could only with difficulty be brought to the normal position under chloroform. The left second and third maxillary molars were removed immediately as they were causing ulceration of the cheek tissues. The X-ray photograph of this patient showed that the mandibular third molar was wedged in between the fragments in a misplaced position. Under chloroform this tooth and the second molar were removed, together with several fragments of necrosed bone. A vulcanite Gunning splint was inserted, but not fixed. The mouth was frequently irrigated. By the beginning of January union had occurred but there was still a tendency for the mandible to drift slightly to the left, although the patient could with a voluntary effort occlude the teeth in normal position. A fixed metal Gunning splint was therefore applied to give complete fixation to the parts. This was retained for one month, and the occlusion is now easily maintained in the position shown in the models (fig. 29).

Case 8.—This man was injured on July 25, the projectile comminuting the right side of the mandible, as shown in fig. 30. He was first seen on September 14, when there was a hard, brawny swelling on the right side, with a deep sinus freely discharging pus. The mandible had drifted considerably to the right, as seen in this

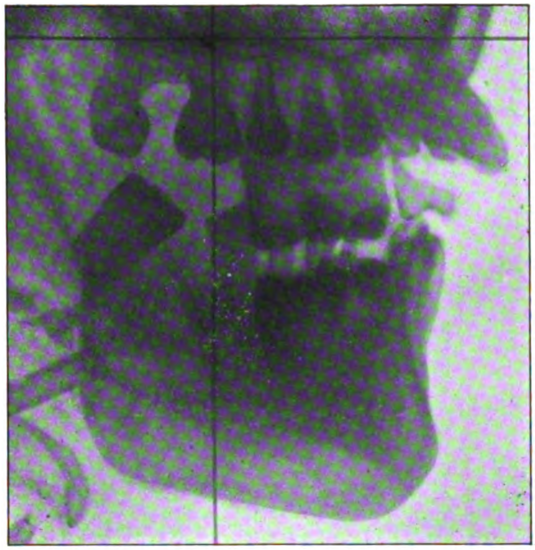


Fig. 30.

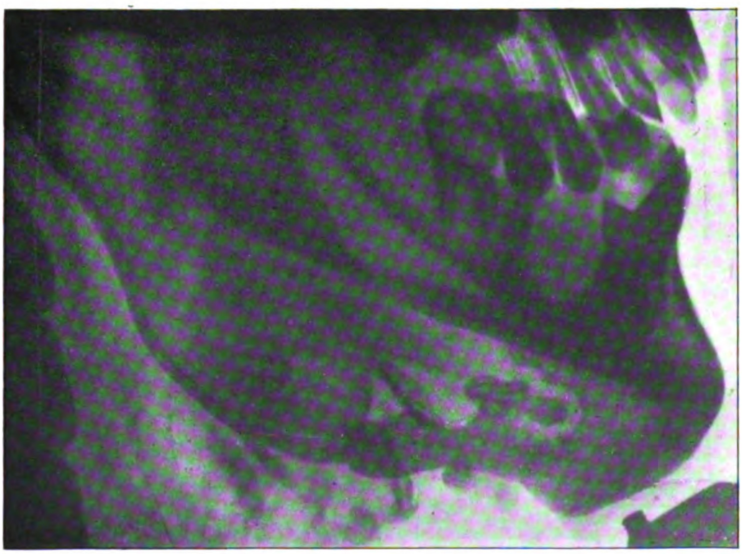


Fig. 32.

To illustrate "The Treatment of Gunshot Injuries of the Jaw," by J. F. Colyer, L.R.C.P., M.R.C.S., L.D.S.

skiagram. The molar tooth was removed on September 17, and the wound in the mouth and the sinus were frequently syringed. A metal Gunning splint was adjusted—the splint was not fixed, and when first inserted, the mandible could only with considerable difficulty be brought into position. Considerable portions of

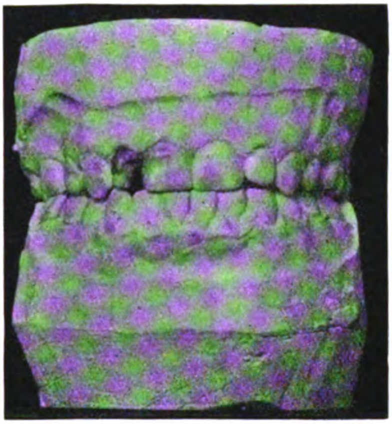


Fig. 29.

Fig. 31.

necrosed bone have come away and at the present time the patient has practically recovered. A slight sinus is still present outside, as there is still a small piece of bone to come away, but the teeth are in perfect occlusion, as is seen in fig. 31, and new bone has formed in the injured area, as shown in fig. 32. This result has

been achieved by drainage, keeping the parts in position, and but little surgical interference.

Case 9.—This man was injured on September 26 and was seen on October 22. The bullet entered about one and a half inches below the right angle of the mandible and found an exit one inch above the lower border of the left ramus, causing a severe fracture as seen in fig. 33. The soft parts on the left side were considerably swollen and the left third maxillary molar was ulcerating the soft tissues; there was a sinus in the mouth leading to bare bone. The deviation

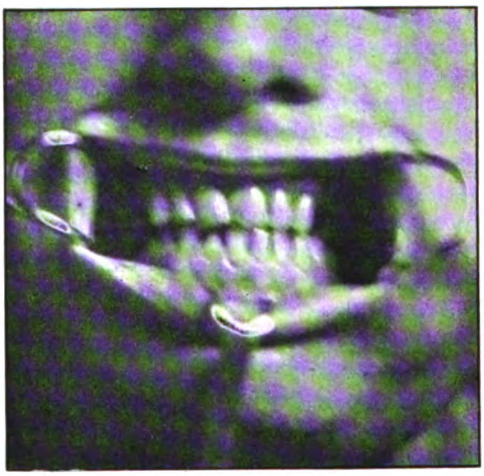


FIG. 35.

of the mandible to the left was slight. On October 30 the mandible was fixed by bands in the teeth and wiring, and the sinus in the mouth was frequently syringed. An abscess subsequently formed and was opened externally, and a piece of necrosed bone was removed. On December 5 the retention wires were removed. As union had occurred the mandible was not refixed, but the use of the external supporting splint was continued. This patient had recovered by the end of January. The X-ray taken at this period is shown in fig. 34 and the occlusion of the teeth in fig. 35.

(6) UNUNITED FRACTURE IN MODERATELY GOOD POSITION.

Case 10.—This man was seen on October 23, having been injured on September 3. The mandible had been fractured on the left side in the region of the premolars. It was a glancing shot, and caused, in addition to the transverse fracture, a horizontal fracture.

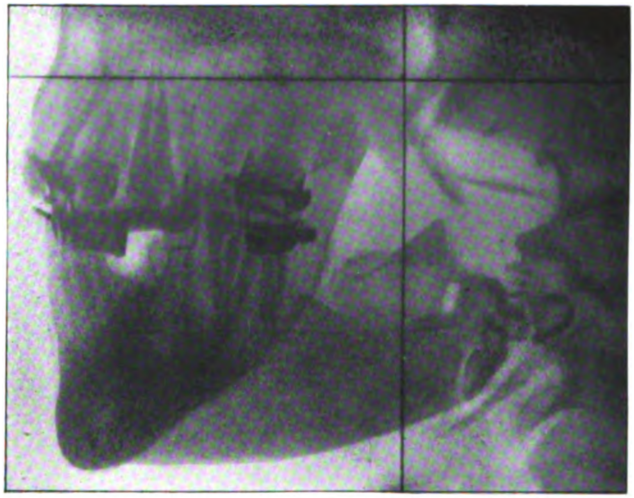


FIG. 33.

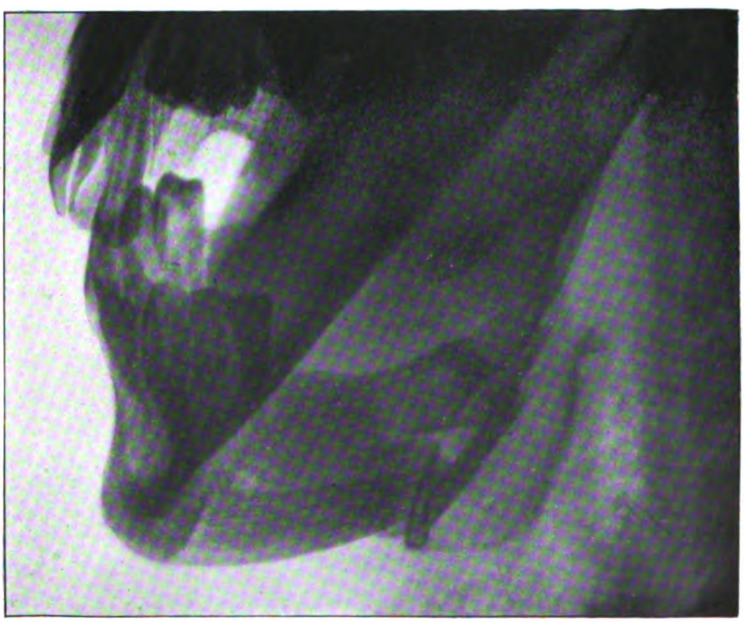


FIG. 34.

To illustrate "The Treatment of Gunshot Injuries of the Jaw,"
by J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S.

When seen there was no union. The molars on the left side were in good occlusion with the upper teeth. The mandible had swung round slightly to the left; the molars on the right side were in moderate occlusion, but the first premolar in the upper passed over the lower teeth. By slightly moving the right fragment to that side the mandible could be restored to good functional position. In this position union could be expected, but with complete replacement there seemed a possibility of only obtaining fibrous union. The former line of treatment was decided upon and a Hammond splint adjusted. This was removed after six weeks, but as union was not complete the splint was refixed, and on January 14 union was complete. On removing the splint the first molar was found to be fractured in an oblique direction and was removed. This tooth, when the splint was originally applied, appeared to be quite sound, but it is more than possible that it was cracked at the time of injury and had passed unnoticed. The presence of this tooth probably accounted for the delay in obtaining union. This case is quoted to illustrate the point that in ununited fractures with fairly good positions the better plan is to allow them to heal in such position rather than risk fibrous union by attempting to obtain an ideal arch.

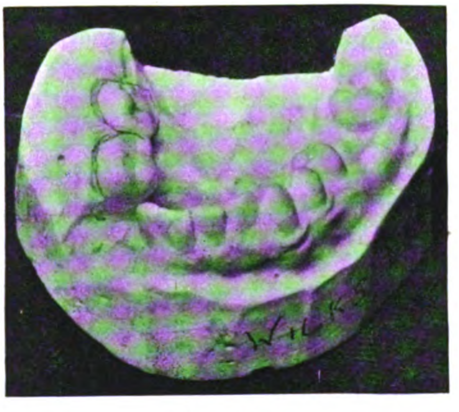


Fig. 36.

(7) Non-union with the Fragments Freely Movable.

There is a definite class of case in which there has been loss of tissue in the region of the premolars and first molar, and the fragments are quite loose. On opening the mouth the anterior fragment slews round to the injured side, but the movement of the posterior fragment varies according to the manner in which the

lower teeth meet those in the maxilla. If the occluding surfaces of the lower meet those of the upper almost directly, then the posterior fragment remains in position, but if the buccal aspects of the lower teeth strike the occlusal surfaces of the upper teeth the posterior fragment is turned inwards, as shown in fig. 36.

This type of deformity could probably be prevented in some cases by the prompt removal of the upper molars to permit the forward movement of the posterior fragment, and also to allow rest to the fragment. The insertion of a bone-graft would seem to be the most satisfactory method of treating these cases. This method of treatment has recently been adopted in two cases.

(8) Union in Malposition.

The treatment of cases where union has occurred in malposition must be determined by the possibility of restoring an efficient masticating area by extraction of teeth and insertion of suitable dentures. If this is not possible, then the alternative of dividing the jaw and obtaining better alignment must be considered. In deciding which course to pursue the following points should be carefully considered :—

(1) To have solid osseous union and therefore a firm basis to bear the brunt of mastication is a large asset.

(2) The mal-union is usually associated with loss of tissue and therefore a diminution of the size of the curve of the body of the jaw. Re-division to be of practical value must be made in such a way that the curve can be restored to the normal. The possibility of doing this depends to a marked degree on the position of the loss of tissue. Mal-union is often seen in injuries involving the incisor region. In this type of case a line must be drawn between cases in which there have been a clear loss of bone tissue, involving both the body of the bone and the alveolar process, such as is shown in diagram, fig. 20, and those in which there is but slight loss of the lower border of the body and considerable loss of the alveolar process, as shown in diagram, fig. 21. In the first type of case, as previously pointed out, the fragments will approximate so that the surfaces engage throughout the entire length, resulting in a restriction of the arch of the body of the bone, and such a condition can only be satisfactorily remedied by re-division followed by the insertion of a bone-graft. In the second type of case the deformity produced is a slight narrowing of the curve of the lower border of the body, but a considerable narrowing of the alveolar portion.

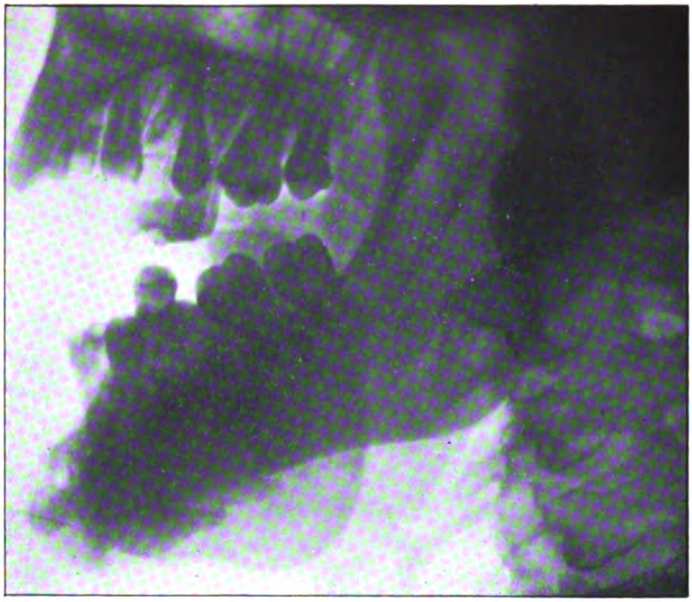


FIG. 37.

FIG. 48.

To illustrate "The Treatment of Gunshot Injuries of the Jaw," by J. F. COLYER, L.R.C.P., M.R.C.S. L.D.S.

Such a deformity can be treated by pressing outwards the two halves by a mechanical appliance or, if the teeth are diseased, by extraction and the adaptation of dentures. In cases of union with mal-direction associated with loss of tissue in the premolar region the deformity as a rule consists in a marked deflection to the injured side of the greater fragment, the teeth in the lesser fragment being in moderately good occlusion. Restoration here can only be made by re-division followed by a bone-graft. In cases due to loss of tissue in the region of the second and third molars, the resulting deformity depends upon the presence or absence of teeth in the lesser fragment. If the teeth are absent from the lesser fragment, this is able to move forward and the deflection of the greater fragment is not great and there is but slight deformity. On the other hand, if teeth are present in the posterior fragment together with the opposing maxillary teeth, then the lesser fragment is prevented from moving forward and the greater fragment is deflected markedly to the injured side and there is marked deformity. It is possible to treat this deformity by re-division of the jaw. The cut must be made in an oblique direction, and the posterior fragment released by the extraction of teeth so that it may pass upwards and forwards.

(3) The possibility of the operation resulting in failure of the bone-graft or non-union of the jaw after division must not be lost sight of.

(4) The value of the teeth to be brought into occlusion requires consideration. If of good value this must be considered a point in favour of operation; if of little value, a point against operation.

The skiagram, fig. 37, is from a case of severe fracture in the incisor region which was followed by good osseous union of the fragments in mal-position.

(9) The Advisability of always retaining the Contour of the Jaw in Cases of Fracture.

This is a question of considerable importance and at present it is not possible to express a definite opinion; the method of treatment to be pursued in these cases in the future will in a great measure turn upon the success of "bone-grafting." Experience would seem to show that where there is loss of tissue involving the body of the bone and the fragments are kept asunder, fibrous union only results. The following may be taken as a case illustrating this point.

The patient was injured on August 28 by shrapnel which, in

addition to inflicting many wounds over the body, fractured the mandible in the incisor region, carrying away the right canine and incisors and the left central incisor. About the region of the central incisor there was a loss of the body of the bone. A cap splint was fixed in France, retaining the parts in ideal position. He was admitted to Croydon early in October; the splint was steady but there were several spicules of bone in the base of the wound. These were allowed to exfoliate. On December 13 the splint was removed and the right first premolar and the left lateral incisor were removed, as they were bare of bone to their apices. A fresh cap splint was applied, but at the time of writing this paper, namely, the end of February, there are no signs of osseous union.

Contrast with this the type of case in which the central incisors are carried away with the body of the bone and the parts are allowed to approximate. Union results in such cases speedily and efficiently. The disadvantage is a slight narrowing of the jaw, which does not make any appreciable difference. I am inclined to think that in cases of small loss of tissue it is better to allow the parts to approximate and ensure osseous union than to risk the possibility of fibrous union by aiming at an ideal arch. In cases involving a large loss of tissue where the approximation of the fragments must cause considerable distortion of the arch, it would seem that the best method is restoration of the contour of the arch with a view to the subsequent insertion of a bone-graft.

(10) The Readjustment of Fragments from Abnormal to Normal Position.

Under this heading reference will be made to the treatment of those cases where a portion of the mandible has been shot away and the part remaining is in an abnormal position. In the readjustment of the fragments I have adopted a plan of stretching, with excellent results. The method can perhaps be best described by recording an individual case.

Case 11.—The patient was injured at Loos on September 28, and was first seen on October 9. The left side of the mandible had been entirely shot away and in the right fragment the incisors were quite loose. There was a wound through the whole length of the left cheek about three inches in length, the surrounding tissues being extremely swollen as is usual in these injuries. The wound was irrigated every two hours and after three days the margins were brought together by deep sutures. The upper incisors were

broken off level with the gums. The man's condition was too precarious to admit of any interdental splint—still further, it was impossible to obtain models, and any splint would have added to the sepsis and probably turned the balance between life and death. By the end of October he was sufficiently recovered to permit of

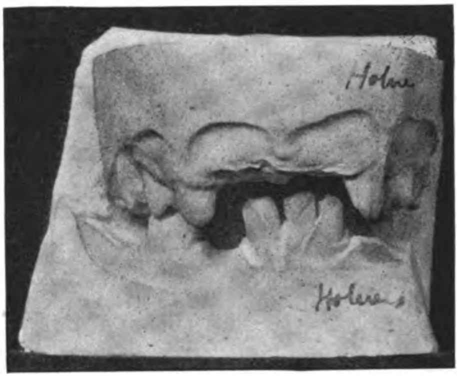


Fig. 38.

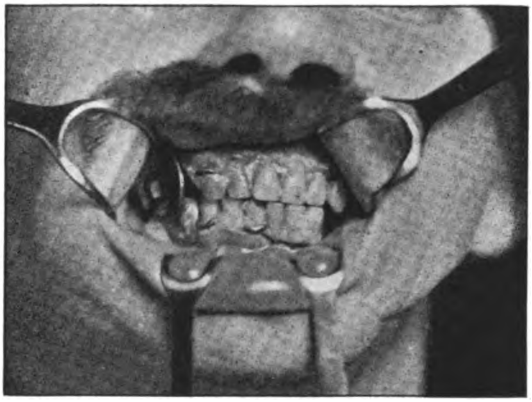


Fig. 39.

treatment for the jaw being undertaken, but in the meantime the right fragment had swung across the mouth, as shown in fig. 38, and could only with difficulty be brought slightly towards the right. The roots of the upper incisors were removed, as well as the loose left lower incisors, and models were with difficulty obtained. A vulcanite cap was made to cover the upper teeth, and a metal

cap to cover the lower teeth. The caps were placed in position and the mandible was forcibly brought over as far as possible to the right side; the two caps were then united. The splint was first adjusted to the upper teeth, and the lower teeth brought over to the right and slipped into the metal cap. This action puts the forming cicatricial tissue on the stretch and for about twenty-four hours leads to a certain degree of discomfort amounting almost

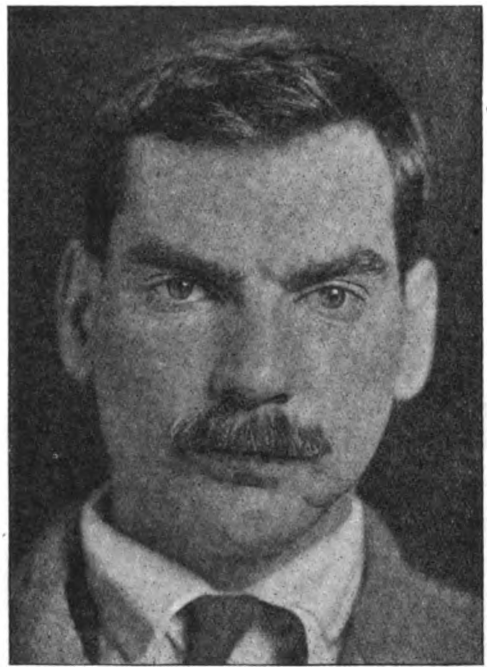


Fig. 40.

to pain. Directly it was found that the mandible could with ease be slipped into the metal cap, the position of the latter was altered more to the right until the fragment was stretched across to the natural position and dentures have been inserted and the parts easily retained in position by means of an engaging flange (fig. 39). A portrait of this patient is shown in fig. 40.

I have found this method of forcible stretching at intervals of real value, especially in cases of ununited fractures with considerable mal-position. For example, in the case shown in fig. 41, the injury was inflicted three months previous to the patient arriving

in the Hospital. By means of two forcible stretches the mandible was brought into the position shown in fig. 42. This accomplished, the splint was fixed with cement to give complete rest and allow the fractured ends to unite.

Another case illustrating this method of treatment is shown in fig. 43. This man was injured towards the end of September and admitted to Croydon the beginning of January of this year. There

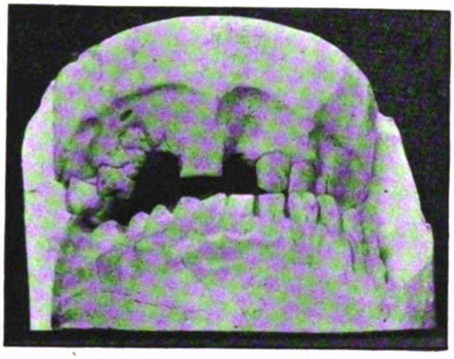


Fig. 41.

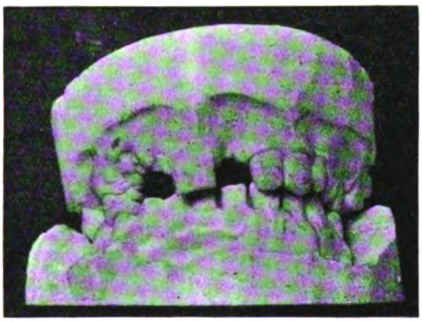


Fig. 42.

was an ununited fracture in the region of the right second premolar and first molar, and a displacement forwards of the right incisors and canines. The right incisors were removed and the alveolar process forced back into position. The position obtained by the first stretch is shown in fig. 44, and that by the second stretch in fig. 45. In this latter position the parts have been fixed preparatory to the insertion of a bone-graft.

The most refractory cases are those where dense fibrous tissue

exists between the fractured ends and the displacement is sufficient to bring the teeth of one side of the mandible out of occlusion. The case shown in fig. 45 is an example. The injury was on the

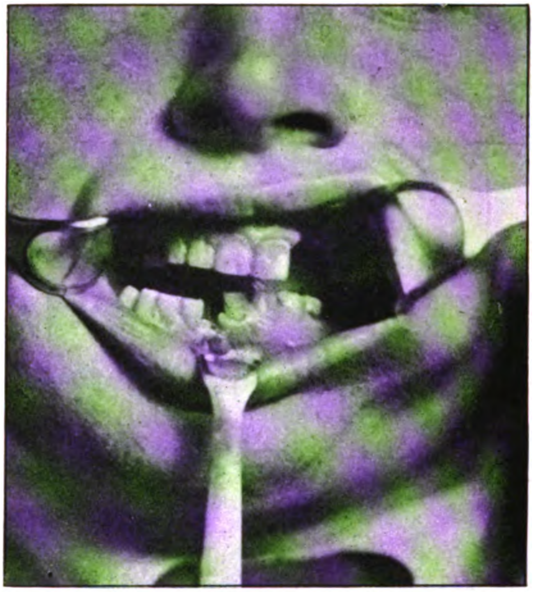


Fig. 43.

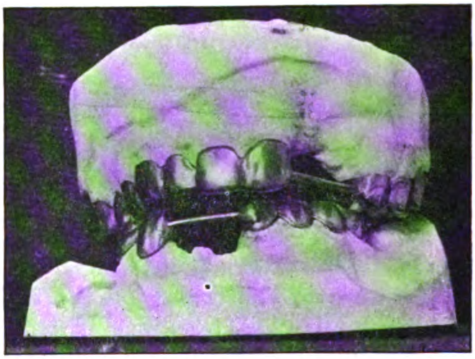


Fig. 44.

right side in the region of the first molar and premolars and the left fragment had swung across so that the remaining teeth, namely, the premolars and molar, were inside the corresponding upper

teeth. In the right fragment there were no teeth. Clearly, treatment should aim at rendering the mandibular teeth functional. By means of a stretching plate this has been accomplished, but it became necessary to remove the right maxillary molars as the drawing of the mandible to the left brought the right fragment which was displaced upwards into contact with those teeth.

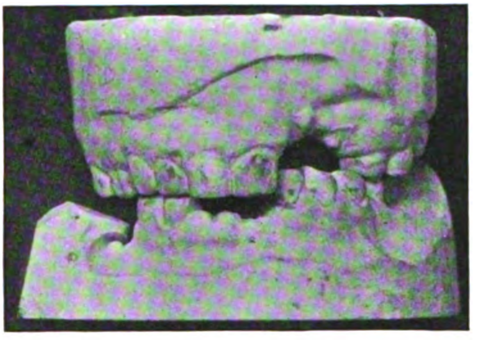


Fig. 45.

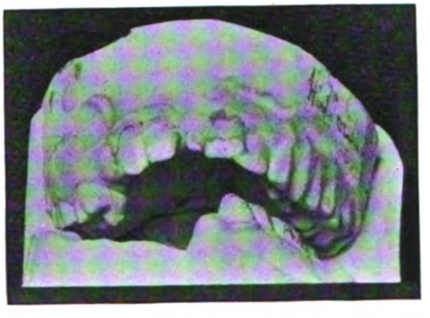


Fig. 45 (*a*).

(11) Deformities following Injury to the Ramus.

In injuries of the ramus in which there is loss of bone, the tendency is for the mandible to be drawn over to the injured side and for the bone also to be drawn upwards on that side. This action is well seen in cases where all the teeth are present, the teeth when the mandible is at rest being in the positions shown in figs. 46 and 47. The injury was on the right side, there being a fair loss of bone. The drag upwards on this side brings the outer cusps of the lower teeth hard against the internal aspect of the outer

cusps of the upper teeth (fig. 46), and the lower cusps then act as a pivot, the upward drag on the mandible on the injured side causing a downward movement of the opposite side and so separating the teeth (fig. 47).

To counteract this displacement the following method of treatment is being used. A cap splint is fixed to the molars and

FIG. 46.

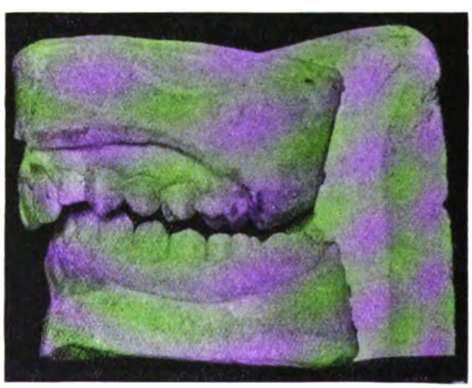


FIG. 47.

premolars of the injured side and to the splint an engaging flange is made to meet the lower teeth. The effect of this is to gag open the mouth on both sides, but considerably more on the uninjured side, so that the muscles on this side are put in an increased state of tension and so tend to pull the mandible up on that side, the pivot still being the outer cusps of the teeth on the injured side.

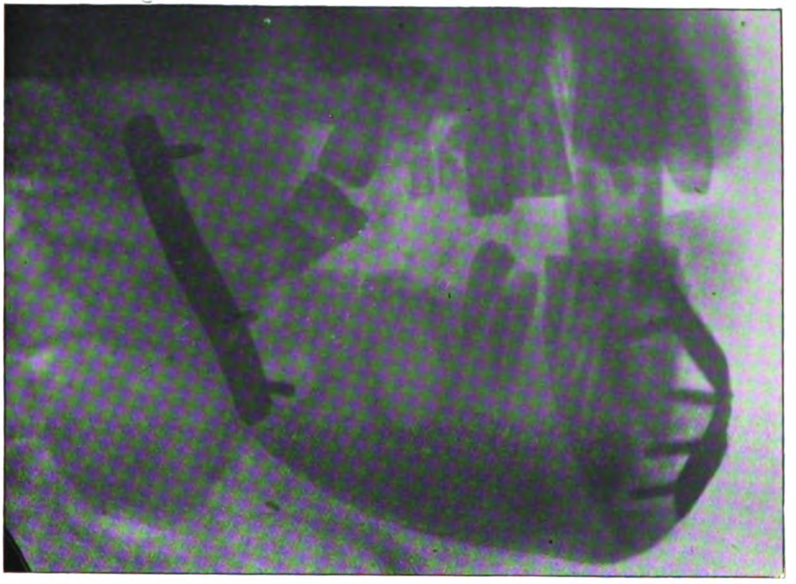


FIG. 49.

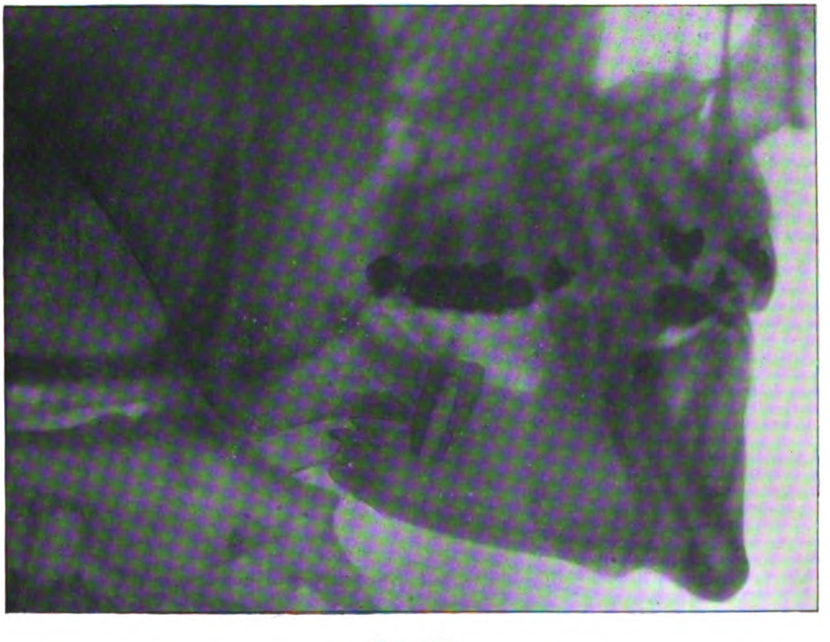


FIG. 59.

To illustrate "The Treatment of Gunshot Injuries of the Jaw," by J. F. COLYER, L.R.C.P., M.R.C.S., L.D.S.

(12) Plating in Fractures.

One patient has come under treatment for whom plating of septic comminuted fractures had been carried out in France. This man was injured on August 9, the bullet penetrating the mandible on the left side in the region of the first molar tooth and finding an exit in the same region on the right side. The left side of the mandible (fig. 48) shows a clear loss of tissue with several septic teeth communicating with the fracture. On the right side the comminution is also marked (fig. 49).

When seen early in October, there were sinuses on both sides and the mandible communicating with the plates and the mouth was full of septic roots; the mouth was open in the incisor region to the extent of about fifteen millimetres, and the mandible was deflected over to the right side. The mouth was cleaned by the removal of the septic teeth, the plates being removed on November 27, when the scar tissue on the right side between the bony fragments was divided and a Gunning splint adapted; the third molars on the right were subsequently removed as they were preventing complete closure of the mouth. The jaw at the time of writing this paper has united, and dentures are being made.

The case is referred to because it exemplifies the uselessness of plating septic comminuted fractures. If this man had been treated by the removal of the septic teeth and the molars, and the adaptation of a Gunning splint following on the forward movement of the posterior fragment on the right side, union would probably have resulted by the beginning of November and the man would have been fit for duty by the end of the year.

(13) Closure of the Jaw.

Fractures in the region of the rami are frequently followed on the repair of the injuries by a considerable interference with the movement of the mandible, due mainly to contraction of scar tissue. The method of treatment by the use of the wooden screw gag is not satisfactory and one has found that a more efficient method is to forcibly stretch the tissues over definite periods followed by rest. The plan adopted is to screw open the mouth at night, the gag remaining in until the morning. The diet, too, should be of a hard character.

A disadvantage of the screw-gag is that it may force the mouth open in an oblique direction, and this is obviously undesirable; the aim should be to ensure an equal distribution of force. This is

obtained in the apparatus figs. 50 and 51, which was suggested by Captain H. M. Holt and made by Mr. Colam. It consists of two curved plates covering the occlusal surfaces of the teeth, the plates being united at each end by screws. The appliance is adjusted to the mouth and the plates are opened to an extent "just not to cause pain."

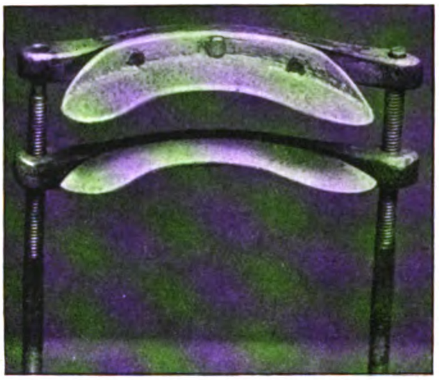


FIG. 50.

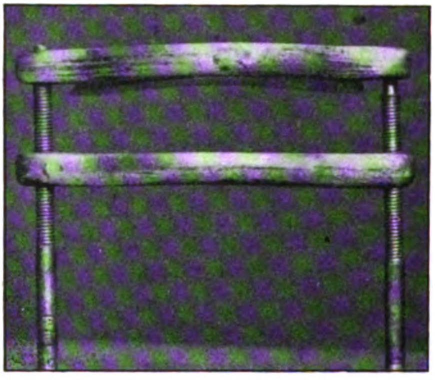


FIG. 51.

(14) THE TREATMENT OF CICATRICES.

Associated with injuries of the jaws there is frequently considerable laceration, and in some cases destruction of the cheeks and lips, healing of the wounds being often followed by a depressed cicatrix attached to the jaws. The soft tissues thus bound down not only considerably restrict the movement of the parts, but at the same time are extremely disfiguring.

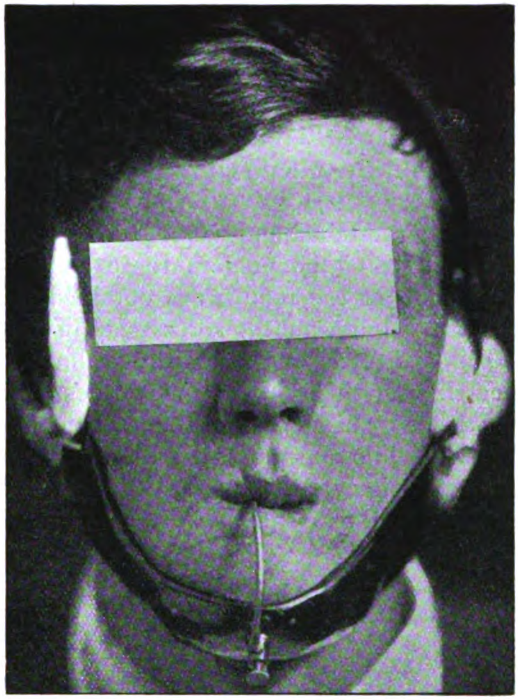


Fig. 52.

Fig. 53.

In many of the cases plastic operations are necessary, but these operations are not so likely to be required or, if necessary, are more likely to be satisfactory if the scar tissue is first severed from the jaw and subsequently stretched and massaged.

The plan that is being adopted in these cases is as follows: When possible models of the mouth are obtained and a vulcanite splint is constructed to bulge out the soft tissues in the region of the cicatrix. The splint is made so as to firmly occlude with the upper teeth. The cicatrix and the adjacent soft tissues are freely divided from the bone with a pair of scissors, the separation being made close to the bone. While the patient is under the anæsthetic the splint is placed in position and modelling composition firmly pressed in between the separated parts, and the construction of the splint

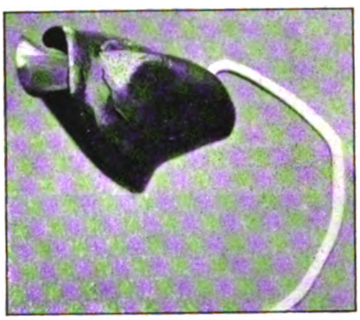


FIG. 54.

is completed. The wound in the mouth is then packed with gauze and the vulcanite splint placed in position within forty-eight hours. Additions are made to the splint from time to time until the soft tissues are in a state of full tension. The stretching of the tissues is assisted by regular massage.

The results we are obtaining from this line of treatment are satisfactory. With some patients the opening of the mouth is limited to such an extent that it is impossible to obtain satisfactory models for a large internal splint. In such cases a piece of vulcanite is prepared to pass into the sulcus between the bone and the lip, the vulcanite being attached to an external splint as shown in figs. 52 to 54. In this patient the lower lip was firmly adherent to the bone, and the opening of the mouth was extremely contracted. The lip is now supple, the depressed cicatrices have flattened out and dentures have been inserted.

Another case treated by the same method is shown in figs. 55 and 56. The adherent lip was freely severed from the bone, and the degree to which the soft tissues have been stretched is shown in figs. 57 and 58.

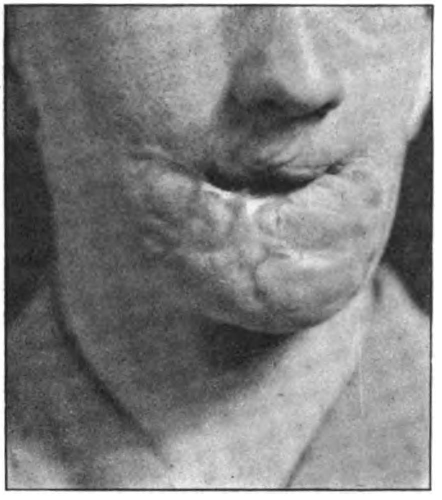


FIG. 55.

FIG. 56.

(15) THE EARLY TREATMENT OF CASES.

In the foregoing remarks one has dealt with cases in which recovery has been prolonged, and when it has taken place has been

unsatisfactory. In many of the cases one feels that the delay has been mainly due either to entire neglect to utilize interdental splints or to the non-recognition of certain underlying principles of treatment. If cases can be brought under proper dental treatment soon

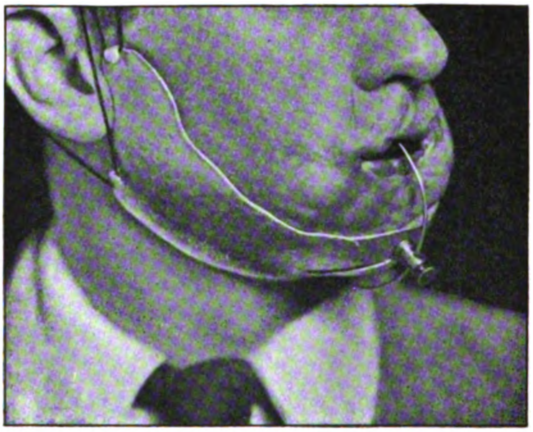


FIG. 57.

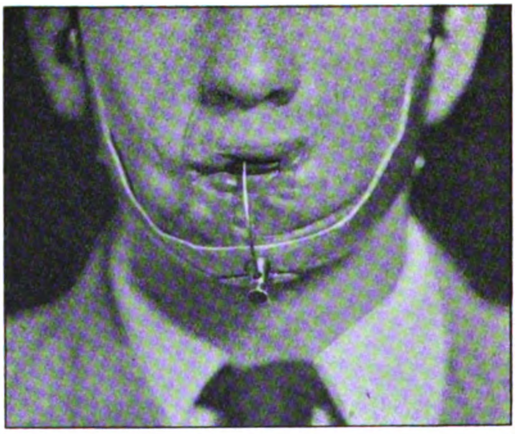


FIG. 58.

after the receipt of injury one can look forward to rapid and good recovery, and I propose to record here four cases as illustrations.

Case 12.—This man was injured at Loos on September 25 and was first seen on October 9. The bullet fractured the mandible on

the right side, posterior to the first molar, as shown in the skiagram fig. 59.[1]

The posterior fragment had moved upwards and overlapped the anterior fragment. There was considerable swelling of the soft parts and the upper third molar was immediately removed as it was ulcerating the tissues in the posterior fragment. On October 17 Angle bands were adjusted to the upper and lower teeth and wired together. On November 20, when the wires were removed, osseous union had taken place and the man was able to eat an ordinary meal by Christmas. The occlusion of the teeth is shown in fig. 60.

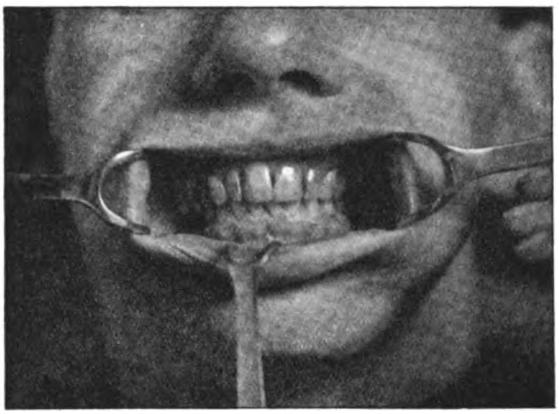


FIG. 60.

Case 13.—The mandible in this case was fractured on the left side in the region of the third molar and on the right side in the region of the angle. He was injured on September 25 and first seen on October 9. The anterior fragment was depressed about five-eighths of an inch and was drawn over to the right. The soft tissues were much swollen and there was a deep wound posterior to the right angle of the jaw. The following teeth were removed.

$$\begin{array}{r|l} 8\ 7 & 6\ 7\ 8 \\ \hline 7 & 8 \end{array}$$

On October 22 a metal Gunning splint was, with considerable difficulty, applied. On November 20 this was removed, union was complete and the occlusion perfect. The man left the hospital before Christmas.

[1] The outline of the posterior fragment has been shaded to give a clearer view of its position.

Case 14.—Wounded December 14 and admitted January 5. The fracture was between the left lateral incisors and canine. The teeth in the left fragment were in occlusion; the right fragment was depressed and pus was welling up at the seat of the fracture. On January 8 the teeth contiguous to the fracture were removed; on January 15 a splint was fixed. This was removed on February 11, the fracture having united.

Case 15.—Injured on November 11 by a horse kick. Admitted December 17. The fracture was between the left lateral and canine, the right fragment being depressed. On December 21 the teeth contiguous to the fracture were removed, a cap metal splint was fixed on December 29, and by January 14 union was complete.

The results obtained during the six months point to the value of bringing cases of injuries of the jaws into special hospitals. The experience garnered from a large collection of cases is obvious, but I think a great point gained is in connection with the nursing of the patients. Injuries of the jaws require special nursing, and the syringing of sinuses in the mouth requires a good deal of dexterity. The rapid recovery of many of the patients has been in a large measure due to the skill and devotion of the nursing staff.

Lastly, I should like to thank Captain Holt, the officer in charge of the Division, for his sympathetic help in this work. His sound common-sense has proved of great value in dealing with the men and helping one to tide over many difficulties. During the last three months I have had the valuable assistance of Lieutenant Edwards, and now the work has increased I have the additional help of Lieutenant H. Stobie, Assistant Surgeon to the Royal Dental Hospital of London.

My thanks are due to Mr. W. H. Smith, for his great kindness in photographing the various cases, and also to Mr. R. F. Colam, K.C., the Recorder of Croydon, who has given his most valuable help in designing and making many of the splints.

REPORT ON "TRENCH FOOT."

BY CAPTAIN W. WALLER.
Royal Army Medical Corps.
AND
LIEUTENANT E. K. RIDEAL
(*Unattached*).

PROVISIONAL DEFINITION OF THE CAUSES OF "TRENCH FOOT."

OUR only first-hand clinical data are derived from a questionnaire of twelve cases of recovering "trench foot" seen in the Hampstead Hospital two or three weeks after the onset. The symptoms appear to be fairly constant and we have grouped them provisionally as follows: (1) Early symptoms mainly due to circulatory disturbance; these are swelling, numbness and pain. (2) Symptoms, outlasting the early symptoms, chiefly nervous in character, and mainly due to prolonged action of water on the skin; these are pain, paræsthesia, blunting of sensation, lowering of excitability of the "motor points" on the leg to faradism, and contracture of the toes or ankle seen in the more severe cases. The early symptoms are said to be similar to those of frost-bite. Frost-bite, however, proceeds either towards necrosis or recovery in a comparatively short time, whereas the condition we have to deal with lasts for a month or longer. We assume, therefore, that water itself is an important cause of "trench foot," because of its action on the skin, apart from its cooling action. It is said that the condition has occurred in cases where water has been excluded, and these cases are attributed to the action of sweat in an unventilated boot. All the cases we questioned either had no trench boots, or if they had, their feet were thoroughly wet when they changed from their marching boots into the trench boot. Moreover, the level of the water came above the top of the trench boot. "Trench foot," therefore, may provisionally be defined as a condition due to prolonged action of water on the skin combined with circulatory disturbance due to cold and inaction. Our work has been confined to a study of the action of water and the means of prevention.

Action of Water on the Foot.

(1) *Physical Considerations.*—Water is an abnormal environment for the skin. Theoretically, there are three actions of the water: (1) Loss of heat due to increase of conductivity and thermal

capacity of the surrounding medium; (2) effusion of salts from the skin; (3) infusion of water into the skin. A normal skin can, of course, resist these actions, but when the exposure is prolonged and the circulation is diminished the osmotic action may become important. This is proved by experience and by the experiments to be described. Fishermen and otter-hunters find that after several hours' contact with cold water there may be some pain, tenderness, and even swelling of the feet, lasting perhaps a day or two. Workers in paper manufactories, who have to stand for a day at a time in several inches of warm water and paper pulp, have similar symptoms. These are not entirely due to circulatory disturbance.

(2) *Experimental Data.*—In order to study the action of water on our own feet, we have worn ordinary "gum boots" for five to twelve hours, the boots being filled to the same level with water and salt water on either side. We find that ordinary tap-water has a more marked effect in a given time than four per cent sea-salt solution. There have been three subjects of the experiment, and in each case the procedure was the same. The boot on one side was filled to a level of about four inches above the ankle with tap-water, and the other boot was filled to the same level with the artificial sea-water. The subject proceeded with his ordinary occupations during the day, and the feet were examined by unprejudiced observers in the evening. One of the subjects showed a marked contrast between the two feet, one of them showed a definite but less marked contrast, and the third showed hardly any difference. The following is a résumé of the experiments:—

(1) Subject R. H. G.—Eight hours' immersion during the day. Ordinary activity and a walk of one mile. Left foot in tap-water: Whiter, more wrinkled and more sodden than right, also less sensitive to touch and slightly colder to objective.

Right foot almost normal, objective effect passed off in about half an hour. Three hours later, after a half-mile walk, cramp was felt at the base of the left toes.

(2) Subject W. W. W.—Duration five hours. Left foot in tap-water. The feet were examined by observers who were ignorant of the purpose of the experiment. The left foot was described as being paler and more sodden than the right foot. The right foot appeared more normal. The difference passed off in half an hour. There was no subjective change.

(3) Subject W. W. W.—Duration eight hours. Right foot in tap-water. Similar changes were described in the right foot. No subjective change.

(4) Subject E. K. R.—Duration eight hours. Left foot in tap-water. The difference between the feet was too slight to be described as definite.

In these experiments the circulation was as normal as possible. The water remained in equilibrium at a temperature of 28° C. to 30° C. and the feet never felt uncomfortably cold.

With a temperature of 40° C., the contrast between the action of salt water and tap-water is more marked. The difference is evident in the feet (W. W. W.) in about one hour, and very definite in two hours.

In all these experiments the exposure was not prolonged enough to cause any lasting effect, but the difference constantly found indicates that, with prolonged exposure, the action of salt water might be slight, and that of ordinary water serious.

We have made measurements of the increase of conductivity of tap-water in which the hand or the foot is soaking. This gives a measurement of the salt emission from the hand. The first measurements were taken ten minutes after immersion of the limb, so as to ensure the removal of superficial salt. At high dilutions the effect of non-electrolytes on conductivity is negligible. Assuming that the increase is due to NaCl, the chief electrolyte in the sweat, the following results were obtained:—

Experiment 1.—Subject W. W. W. Hand in vessels containing 1·25 litres of tap-water at 40° C. Samples of seventy cubic centimetres of the water were taken at twenty minutes' intervals for measurements at 18° C., and each sample was then poured back into the large vessel. Decrease of resistance in two hours equals fifteen ohms, equivalent to fifteen milligrammes of salt.

Experiment 2.—With the temperature at 18° C., the decrease of resistance measured at 18° was thirteen ohms, equals thirteen milligrammes of salt.

Experiment 3.—Subject E. K. R. Hand in 1·25 litres of tap-water at 40° C. Differences of resistance at 18° equals eight ohms, equivalent to eight milligrammes of salt emitted.

Experiment 4.—Subject W. W. W. Foot in three litres of tap-water at 40° C. Difference equals 16½ ohms in two hours, equivalent to thirty-eight milligrammes of salt.

In all these experiments the chief difference occurs in the first hour, after which there is a slower change, and by the end of the second hour no further increase of conductivity can be measured.

The effect of the water on the hand also becomes visible in about an hour's time, and it seems probable that when the salt has

stopped diffusing out from the hand the water begins to soak into the skin, producing the transient changes described above.

Of the two subjects, E. K. R. shows a lower susceptibility to the effect of tap-water and also shows a lower salt emission.

Protection of the Foot from Water.

We are not concerned here with the various kinds of waterproof boots and socks. We have been told that "trench foot" occurs in cases where water has been excluded, and it was suggested that we should experiment with various kinds of grease in order to find one which should be impermeable to sweat, and should thus prevent the accumulation of sweat in the sock. It was suggested that sweat which has a salt concentration of, say, 0·5 per cent has the same injurious effect on cold feet as stagnant water. It would no doubt be possible to find a varnish impermeable to water in either direction—e.g., collodion—but we have only experimented with the natural fats, lard and tallow and whale oil, with spermaceti and whale oil, and with paraffin. We cannot find any constant difference in the action of lard, tallow, whale oil, paraffin, or mixtures of whale oil and tallow. They all cause a diminution of about fifty per cent of the transpiration. We may presume, therefore, that there is no marked difference in their relative permeabilities to water from outside. Owing to the extreme variability of the sweat it is difficult to get concordant results. The most constant results were obtained at 36° C. with a nearly saturated atmosphere. Several experiments were done at 11° C., 40° C. and 45° C. They showed diminution of sweat by fat of the same order of magnitude.

Method.—Hand and forearm enclosed in plethysmograph immersed in a water-bath, upper end of plethysmograph projecting into the air. Air, previously dried by sulphuric acid and warmed to temperature of the water-bath, was drawn at a constant rate through the plethysmograph and then through two weighed $CaCl_2$ tubes in series. A by-pass tube was fitted in parallel with the $CaCl_2$ tubes. In each case fifteen minutes were given to establish equilibrium, and then the air from the plethysmograph was cut off from the by-pass and sent through the $CaCl_2$.

At the end of the experiment the hand was drawn out and plethysmographed, dried by the current of air, its open end being closed by a large glass stopper.

For each ointment tested a control experiment was previously made on the naked hand. The average amount of sweat was three

grammes per hour without ointment, and one and a half grammes per hour with ointment.

Ointment	Percentage reduction. Average of three experiments
Lard	45 per cent
Tallow	42 ,,
Whale oil	55 ,,
Whale oil and tallow	52 ,,
Lard + 4 per cent sea-salt	60 ,,
Tallow + 4 per cent sea-salt	60 ,,
Spermaceti + whale oil (50 per cent)	58 ,,

All the above experiments were done at 36° C. with a flow of air of one and a half litres per minute.

At the higher temperatures with same rate of air-flow the normal transpiration actually became slightly less on the same day :—

Temperature	Rate of perspiration
36° C.	3·41 grammes per hour
40°	2·98 ,, ,,
42°	2·75 ,, ,,
45°	2·07 ,, ,,
36°	2·95 ,, ,,

The reason for this fall is probably that at the higher temperature the air was less saturated, and consequently the sweat was evaporated in a more " economical " way at the skin surface. The diminution produced by fat was about the same at the higher temperatures.

At a temperature of 11° C. an output of sweat of about one and a half grammes per hour in a saturated atmosphere was diminished by sixty-five per cent.

It is impossible to compare the amounts at different temperatures owing to the difference in degree of saturation.

These experiments were of short duration, i.e., fifteen minutes' preparation, fifteen minutes' test and fifteen minutes' drying after taking the hand out. With longer experiments no doubt the resistance of the ointment to water would be broken down, but our object has been to compare different ointments.

Incidentally we have tried the effect of lard on the heat emission of the hand and forearm immersed in a constant-flow water calorimeter. We find that the calorie emissions varying from 150 to 300 calories per minute were not appreciably affected by smearing lard over the skin. Subjectively, however, the water felt warmer when the arm was smeared with lard, though the water temperature remained the same. This is probably due to the

temperature gradient being less steep with the greased hand and the effective protecting layer being thicker.

Salted Ointment.—Having found that salt water had less effect on the skin than tap-water, we have tried lard with four per cent sea-salt made up into an ointment.

The figures given above show an apparent reduction of sixty per cent of transpiration compared with fifty per cent for ordinary lard. It is extremely probable that the real transpiration is not diminished but possibly slightly increased, and that the apparent decrease is due to the lowering of the vapour pressure of the sweat by the salt. The following calculation appears to confirm this hypothesis. Percentage lowering of vapour pressure is given approximately by the formula:—

Percentage lowering $= 100 \times \frac{n}{N}$ where n mols of salt are dissolved in N mols of water. In fifteen minutes $\frac{0 \cdot 8}{18}$ mols of water are formed, and since about five grammes of four per cent salt lard are used $\frac{0 \cdot 2}{58}$ mols of salt are present. This gives a percentage lowering of vapour tension of eight per cent, a figure which agrees with that experimentally found.

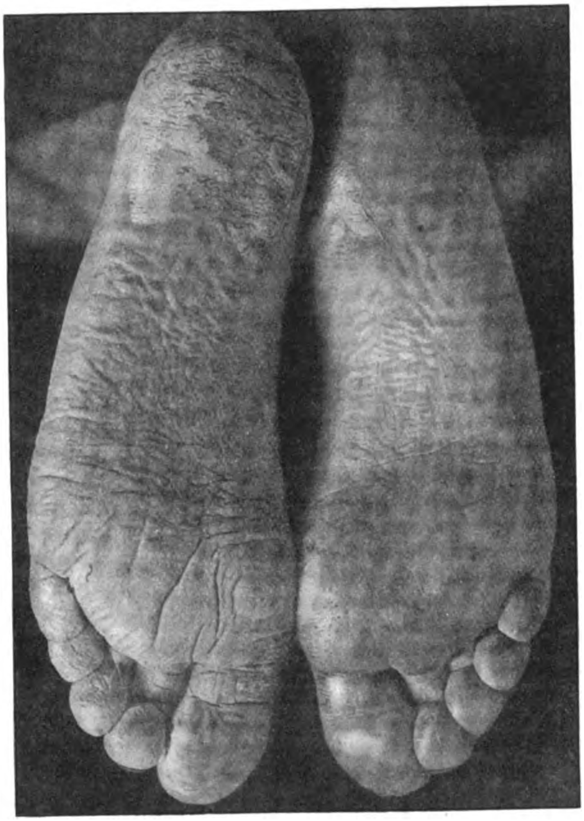
We have also tried the effect of tap-water in a gum boot on the legs, one leg being smeared with lard and the other with salted lard. The difference in appearance is in this case much slighter, after eight to twelve hours, than it was with tap-water and salt water on the non-greased skin. Ignorant observers were, however, easily able to distinguish which was the more normal foot. The foot with salted lard recovered its colour quicker than the other and was slightly less wrinkled and less puffy.

Conclusion.

We suggest that a salted ointment such as salted lard would be beneficial in protecting the foot against water. The salt would further act as an antiseptic. A liberal amount of ointment would be necessary, e.g., 100 grammes for each leg with five or ten per cent salt.

We assume that all other practical precautions have been taken, such as foot inspection, so as to ensure the men using the ointment, provision of dry socks with the waterproof trench boots, loosening of the puttees, etc.

N.B.—Officers' spiral puttees contract five to six per cent of their length when they are soaked in water.



R. H. G.'s feet after eight hours' immersion.—Right foot in six per cent sea-salt solution; left foot in tap-water. The water was put into the "gum boots" at room temperature and was 29° C. at the end of the experiment.

Description of feet.—Left wrinkled, whiter than normal with sodden skin; right slightly wrinkled, normal colour. General appearance practically normal.

CONTRIBUTIONS TO THE STUDY OF SHELL SHOCK: (II) BEING AN ACCOUNT OF CERTAIN CASES TREATED BY HYPNOSIS.

By Major CHARLES S. MYERS, F.R.S.

Royal Army Medical Corps. (T.C.)

In this communication[1] I propose to describe a selected few of various cases of "shell shock" which I have had the opportunity of treating in France by means of hypnosis.

Total Amnesia.

Case 4 (Case Number 390).—Pte. —— admitted into a field ambulance, and seen by me there three days later, having been found wandering in a neighbouring village, clad only in his shirt and socks. He is unable to give his name, regiment, or number. He thinks his age is between 20 and 30. I try him with various Christian names, but he replies that none of them seems familiar to him. He can remember two men finding him as he was strolling on the outskirts of a village, and can describe everything that has occurred to him since then. There is no means of identifying him, and his past is a complete blank; he can recall nothing, for instance, of the events of his childhood.

He appears considerably depressed at his condition; he says that he wishes he could recover his memory, and that it would be a worry to his "people," if he has any belonging to him. He does not complain of any aches or pains, only of numbness over the occiput. His legs are tremulous as he lies on his stretcher, his hands are tremulous when held out, and his tongue is faintly tremulous on protrusion. His left arm and leg and the left side of his face (not scalp), chest and abdomen are hypalgesic; his voluntary movements are normal. His reflexes, superficial and deep, are normal, save that the knee-jerks are exaggerated and a pseudo-clonus is obtainable at the left knee and at the right ankle. His pupils react very actively to light; there is no limitation of visual fields, and eye movements are normal.

He has slept fairly well since his admission to the field ambulance, but complains of a nightmare on the night before my visit, when he dreamed that he was in the trenches throwing bombs,

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[1] The first of these communications appeared in the *Lancet*, February 13, 1915.

and that the Germans threw one at him which hit him in the nape of the neck, waking him up "in a cold sweat."

Under hypnosis, into which he easily passes, he first repeats to me his dream. Then his thoughts turn to his mother living in a small house in the country, "near a big town, where they make anchors and chains." He recalls working with his father as a labourer on hayricks. All this information has to be dragged from him piecemeal with considerable difficulty. He next recalls the names of the village and of the manufacturing town near by. Then he gives me his own name, regiment, and number, but always with uncertainty, qualified, for example, by the words, "I think." Finally he is persuaded to describe what happened after the bomb-throwing (for his dream turns out to be an actual event): "I must have gone off my head and run away"; "I must have taken off my clothes in a field"; "I spent the first night under a hedge"; "I spent the next two nights in a wood"; "I ate nothing." "The next night I was walking along a road on the outskirts of a village, and I was taken to a house by two men." These data, like the preceding, are only extracted with great difficulty and after much persuasion.

When he woke from hypnosis, the suggestion which I gave him before waking that he will remember all that he has told me proves only imperfectly effective. He cannot remember his name, regiment, number, nor the names of his native village and neighbouring town. But, in reply to further questions, he has a vague recollection of having been dreaming of his mother and of his wanderings, and he can be induced to recall them as well as his former occupation, the town where they make anchors and chains, etc.

When he is re-hypnotized without delay his memory becomes much clearer and ampler than before, and he is far more certain of his past history. He recalls, for example, the standard (seventh) at which he left school (at 14), and a punishment he had received since enlistment for "cheeking" a sergeant. Then he tells me that he has been in France for eight months, and had enlisted nine months previously. A much more powerful suggestion is brusquely given, followed by a complete recovery of memory on waking from this second period of hypnosis. His entire expression changes, his pupils become larger, and his despondency disappears. At the same time the previous occipital numbness and left-sided hypalgesia vanish.

Transferred to a base hospital, and thence for three weeks to a hospital in England, he has made an uninterrupted recovery, and has now rejoined his unit.

RHYTHMICAL SPASMODIC MOVEMENTS.

Case 5 (Case Number 362).—Pte. ——, aged 23, seen by me at a casualty clearing station the day after admission. Three days ago, he says, the Germans sent over "whizz-bangs and coal-boxes" in reply to our shelling, and he has been told that he "got pitched up in the air." But the last thing he remembers of the occasion is being on guard, the next is digging himself out of the fallen sand-bags. He remembers running then to the shell trench, but he "found this too hot" and returned to the firing trench, going to his dug-out, when he noticed that his eyesight was defective. He lay in the dug-out, flinching each time a shell came and "trying to get into the smallest possible corner." At night he came out to endeavour to "do guard," but someone noticed that he was making involuntary spasmodic movements which had begun a short while previously. He was ordered to return to the dug-out, was helped to the regimental aid-post by a man on each side of him, and was sent to hospital. He enlisted for the War, and had been in France eight months. He had also "got shook up a bit" four months ago, when five or six bombs threw dirt in his face. His hands and his handwriting then became shaky, but he did not "report sick."

His appearance is that of a strong, robust and honest man. He seems depressed and begs me to make him well. His most noticeable movements are in his legs, but occasionally he shrugs his shoulders. On admission, I am told, the latter movements were much more marked, and he kept diving beneath the bedclothes, bringing up his knees to meet his chin. To-day the leg movements are due solely to periodic simultaneous contractions of the two sartorius muscles, the rate of contraction of which varies from 60 to 70 per minute, increasing to 90 during the excitement of examination. These involuntary movements were observed by the sister to continue during apparent sleep. Pulling down the patella is found to inhibit one or two contractions of the corresponding sartorius. His knees remain extended when the thighs are passively raised from the bed. He complains of severe headache, "as if I had had a hammer dropped on my head." His legs are very tremulous, especially when he lifts them; his hands and tongue are only faintly tremulous. His right leg and arm, and the right side of the face and chest (not the abdomen), present certain disturbances of sensibility which can be better described in a later communication devoted to this subject. His voluntary movements are normal. Only the patellar and plantar reflexes are examined. Of these the

former are much exaggerated, while the latter cannot be elicited, probably owing to the rigidity of the feet. His pupils are of moderate size and react normally to light; visual fields and eye movements appear normal.

Under hypnosis he is able to recall all the events during the period of his previous amnesia. He remembers the direction from which the shell came, how he was lifted up, how he fell on his back, etc. As he passes into a deeper state of hypnosis, the contractions of the sartorius muscles become very much diminished but do not absolutely disappear. Before rousing him from hypnosis, I suggest that now and on waking he will lose his headache and his involuntary movements, and that he will recover his spirits and his memory. The movements at once cease and he awakes able to stand, absolutely free from his headache and spasmodic movements, with recovery of memory, and, as other observers spontaneously observed, "looking another man." The previous unilateral disturbances of sensibility are found to have disappeared. He is transferred to a base hospital.

MUTISM.

Case 6 (Case Number 19).—Private——, aged 32, seen by me the day after admission to a base hospital, completely mute but able to read and write. He writes: "I was buried alive on—— and again on—— (five months and four and a half months respectively before admission), and then I had the misfortune to have two shells burst over me on—— (four days before admission). There was shelling for about twenty minutes and then two bursted over my head. I did not remember any more until you came to see me, but I am still living in hopes to regain my speech back." In reference to his first burial he also writes that he afterwards wandered with Lance-Corporal—— for two days, but that his memory for these two days is completely gone; his comrade and he finally came across men of the French Artillery, who enabled them to rejoin their regiment. He cannot recall how he got his food during those two days. He says that this time, although he found a piece of shell in his tunic, he was unhurt, but that on the first occasion he fell and hurt his back, and suffered for some time from pains in the back and head, and from insomnia, which have recurred now.

His understanding seems slow and his look is vacant. Occasionally he makes jerky movements of the arms, and a noise like a snore comes from his nasopharynx. His voluntary movements are restricted, weak, slowly executed, jerky and inco-ordinated, but they

are not tremulous. He cannot raise his arms above his head, nor can he keep them raised in front of him. Even with his eyes open he fails to touch his nose with his index finger-tip, and he stands very unsteadily. The sense of position appears to be unimpaired (cutaneous sensibility not examined). The only vowel he can imitate is A (Continental pronunciation), the only consonants S and P. His knee-jerks are exaggerated, the plantar reflexes are flexor, the abdominal reflexes cannot be obtained. His pupils are widely dilated but react well to light. His eyes move normally. His visual fields are somewhat restricted on the temporal side. He cannot hear a faintly ticking watch, even when in contact with either ear, but he hears better by air than by bone-conduction. His bowels have not been opened since the shock, *i.e.*, for five days. He passes urine voluntarily now, but during the journey to the base he was catheterized in the train. On my visit, the third day after admission, he seems much brighter, and his movements have improved in extent, speed and co-ordination. He begins to imitate monosyllables, and he explains in writing that he "cannot think how to speak," feeling "just like an infant."

By the seventh day, all signs of stupor and ataxia have disappeared. With great difficulty he manages softly to repeat after me the names of the county borne by his regiment and of the village in which he lives. Next day he can give me these names in response to my questions, and can give me the Christian names of his wife and child. He sweats profusely during these efforts. He never speaks of his own accord.

Sixteen days after admission, his speech is improving, but he shows me a report he had written out for me of his condition, and in so doing burst into tears. Apparently to-day he had overheard a sister expressing the opinion that he is a malingerer.

Under hypnosis, he speaks distinctly more fluently, although still with feeble voice power; but on being questioned about trench life he becomes extremely emotional and suddenly awakes, wiping the sweat from his chest.

On the following day, under hypnosis, his speech is at first slow and hesitating, as if he is disinclined to speak. Finally, after repeated suggestions and encouragement, he is induced to recall the forgotten events on the second occasion of being buried. He names the man who pulled him out of the trenches and describes the hospital to which he went and his train journey to this base. He responds readily to post-hypnotic suggestion that on waking he will remember all that he has told me, will be able to speak louder

and more fluently, and will perform certain somewhat eccentric actions.

Three days later (three weeks after admission) he appears a normal man, save for slight deafness and the complaint of "coming all over of a shake" when he hears a gun fired. He moves and speaks naturally, and his spirits are excellent. He has no recollection of telling me his forgotten experiences under hypnosis, but he can now recall all that he has told me and more. His loss of memory has wholly disappeared, save in reference to the two days' wandering which followed the first occasion of burial. Under hypnosis to-day he recalls that he spent those days wandering over open country with Lance-Corporal ——, that they fed during the first day mainly on potatoes, which were cooked for them in a farm by a woman and her husband, that they spent that night in the open, and that they found the French on the following day. He is transferred to-day to a hospital in England.

Stupor.

Case 7 (Case Number 63).—Private ——, aged 29, admitted into a base hospital and seen by me on the following day. He is in a condition of pronounced stupor, and has to be repeatedly roused from his apparently dazed condition in order to obtain his attention. He cannot recall his name, regiment or age. He can neither write nor read words; he can name a few letters in very large type, but is liable to confusion. Twice he says "water," "comrade," and then makes a gesticulation of falling. He is not deaf. He agrees that a shell came. He complains by gesture that he has pains in the forehead. His gait is normal, but he cannot hold his hands out for many seconds without dropping them. His patellar reflexes are brisk, his pupils react to light normally (cutaneous sensibility not examined).

Four days later, his condition is only slightly better. He has never spoken voluntarily; he is still unable to give his name, but he is more readily attentive and replied "yes" when asked if his name is——. With great effort and after much encouragement he writes his name. Again he complains, by gesticulation, of severe headache.

On the following day, he can give me voicelessly the names of his two children. He can still only read capital letters, but once more confuses some of them. He cannot read aloud the figure 2, but can express its meaning by holding up his two fingers. The next day he shows me his wife's photograph, and with great effort, syllable by syllable, of his own accord gives me her name.

A week after admission, his speech being still extremely limited and laboured, and his memory of his recent experiences being still unobtainable, I subject him to hypnosis, in which state, after much persuasion, I induce him to talk about the events that have preceded the onset of his disorder. He becomes very excited, breathes rapidly and makes gestures showing the positions of the various items in the scenes he begins to describe, evidently visualizing them vividly. Hoarsely and breathlessly, he explains in broken sentences how he was in the trenches and was sent to draw water at a pump when two or three shells burst over him, knocking him down. There seeming a sufficient recovery on the first trial of hypnosis, he is awakened after certain post-hypnotic suggestions have been made to him; these he carries out. He can repeat all he has told me under hypnosis, speaking with considerable effort, but with far less emotion and with enormously improved fluency and speed. He can now give me his home address.

Two days later, no further recovery of memory having occurred, I hypnotize him a second time, whereupon he describes to me how after being shelled he lay on the ground in a dazed condition for some minutes, and how he then rose, picked up the bottles and returned to the trenches, after which he "lost all sense and reason." He says: "I remember my mates telling me I was silly. It was time for us to be relieved at the trenches, but I don't know how I went back with the boys; it was only a short distance to the village. After that I remember nothing until you tried to make me speak." By further persuasion I elicit from him full details of the still-forgotten interval, how he got back to his billet, took off his equipment, lay down, and was wrapped in a blanket by one of his comrades. "I remember going to the doctor's, complaining of a bad headache. . . . I remember a jolting ride, and then I lay on a blanket in a big room full of men." By now he recalls the whole of his forgotten experiences, including the train journey down to the base.

On the following day, being asked whether he does not feel himself again, he complains that he still writes with very great difficulty and inaccuracy, that his speech, like his writing, is not so rapid as normally. His writing is certainly very laboured. Consequently he has not liked to write home to his wife, but has been obtaining the services of a fellow-patient for the purpose. Under hypnosis, his speech and writing are restored to their normal rate. He learns to say with astonishing rapidity the verses, "Peter Piper picked a peck," etc., and is induced to write a letter to his wife at

very good speed. Post-hypnotic suggestions that on waking he will repeat these verses and write the same letter to his wife, and that he will hereafter write and speak with normal ease and rapidity, are absolutely successful. He is discharged two days later to a hospital in England and has since been passed for foreign service, his occasional severe headache preventing him from service in the field.

General Remarks.

Malingering.—After nine months' special work in France and Belgium upon these disorders, I have not the slightest hesitation in maintaining the genuineness of the cases above described. The condition of hemi-hypalgesia in Case 4 and the peculiar disturbances of sensibility mentioned in describing Case 5 have occurred in numerous other cases which have come under my observation. The persistence of the spasmodic movements during sleep, their confinement to the sartorii, and the spastic condition of the legs in Case 5 also point to the absence of malingering. So, too, do the severe constipation and retention of urine in Case 6 and the mode of progress towards recovery in Case 7.

Condition before Hypnosis.—Although these cases have been described under headings which are determined by the most prominent disorders characterizing them, it will be seen that certain disturbances are common to all, e.g., amnesia, varying from complete obliterations of the past to oblivescence of the scenes occasioning and following the shock, severe headache, and a mental condition varying from slight depression to severe stupor. Disturbances of sensation and movement may be absent or, if present, extremely variable. Mutism, when present, had begun to disappear by the time hypnosis was attempted. The stuporose condition was also disappearing by that time.

When in a state of severe stupor, all that could be obtained from the patient were remarks as to the shelling, as if his condition were due to the concentration of the patient's attention on the scenes which had upset him. A little later, an alternation of states often occurred. One subject, for example, whispered to me: "Did you see that one? . . . it went up on top." "What now?" I ask. "They keep going over," he replied. Unable to catch a remark, I asked: "What did you say?" "I was talking to my mate," was the reply. To my question: "What were you saying?" he answered: "Get rifles." This subject could be made to realize he was in hospital, but explained his inconsistent behaviour by the remark "Can't help it, I see 'em and hear 'em" (the shells).

In another case of apparent depression, accompanied by deafness, the latter symptom was found to be very largely due to inattention, his thoughts repeatedly flying to the trenches. For a few minutes his attention could be gained, but then his answers became absent; the question: "How old are you?" for example, receiving the reply: "It passed my right ear." He would often ask me to speak louder when on the point of lapsing into thoughts of trench life. In another case, the alternation of states was so marked that, on being unduly pressed for his thoughts when in a stuporose condition, he assumed an attitude of hostility, rushing about the room with an imaginary rifle in his hands.

Indeed, in all these cases, whenever the memories dissociated from the normal personality were revived, they were accompanied by an outburst of emotion, sometimes of frenzy, but generally of fear. But in the cases described in this communication it was impossible to obtain any revival of the lost memory. Not even in dreams did it return. When such patients endeavoured to think of their forgotten experiences, their headache became so severe as to prevent them from further effort. When, if mute, they endeavoured to talk, they complained generally of a pain in the throat, usually as if someone were gripping their thyroid cartilage.

Condition during Hypnosis.—These pains appeared to constitute the guardians of the condition of amnesia; any effort on the patient's part to break down the latter generally resulted in increased severity of the former. It is therefore not surprising that pains frequently caused the patient to wake from hypnosis as soon as his attention was directed to his forgotten memories or when attempts were made to get him to speak. Experience soon taught me that before I could induce free speech during hypnosis I must first dispel, by suggestion, all pain, soreness or discomfort in the throat, and that, before I could hope to revive lost memories during hypnosis, I must first suggest the disappearance of headache and prevent the recurrence of any trace of it. Even then there was frequently a strong disinclination to talk of the forgotten periods, as if they were being actively inhibited or "suppressed" rather than as if they had been passively "dissociated." When at length this reluctance was overcome, the attitude of the patient often changed from depression to excitement, especially when the former condition had been well marked. His pulse and respiration increased in frequency, he sweated profusely and not infrequently showed clear evidence of living again through the scenes which were coming vividly to his mind.

Condition after Hypnosis.—There usually followed a distinct change in the attitude of the patient. His previous despondency vanished; he was delighted at having recovered his speech and memory. Sometimes the change was so well marked as to appear like an alteration of personality. In the case of one patient, for example, who had recovered considerably from stupor and mutism before I saw him, but who was still in a miserable, lachrymose and dejected condition, I was able to cure his amnesia by means of hypnosis, and to bring about the following changes, the account of which I extract from my note-book.

During hypnosis I suggested that on waking he would remember the past, forget that he had already told it me, and say that he felt quite fit and was ready for a job of work in the hospital. This he did, but talking in the same semi-stuporose manner as before hypnosis. Just as he was going out of the door, I clapped my hand on his shoulder and asked: "Now what about those shells, D——?" His manner almost instantaneously changed. His voice and way of speaking seemed as if of another person. He brightened up as he rattled off a quite coherent and interesting story. He bore himself like a good soldier and returned to his ward, where everyone was amazed at his changed demeanour and he proclaimed himself quite well.

In the four cases described at length in this communication, similar but less marked changes followed the awakening from hypnosis. Increase in the size of the pupils was also noted in one of them, while in two other cases, not here recorded, the pupils, widely dilated before, now returned to a normal size. In another case the patient said that before his memory had been restored to him through hypnosis his mind was continually "rambling" from one train of thought to another, whereas afterwards it "worked as usual." Other post-hypnotic changes also occurred, in which previous suggestion (during hypnosis) played no direct part. The best marked of these was the disappearance of disturbances of cutaneous sensibility (Cases 4 and 5).

The Results of Hypnotic Treatment.—At the time of writing[1] I have hypnotized or attempted to hypnotize twenty-three cases of shell shock. The conditions under which I worked were such that no patient was subjected to further hypnotic treatment unless he

[1] Since this was written I have had opportunities of practising hypnosis on several other cases.

proved readily hypnotizable on the first trial. The immediate results may be summarized:—

(1) Apparently complete cures, 26 per cent.
(2) Distinct improvement, 26 per cent.
(3) Failure to hypnotize, 35 per cent.
(4) No improvement after hypnosis, 13 per cent.

The patients included under (4) were (*a*) two afflicted with deaf-mutism, to whom suggestions of hypnosis could consequently be conveyed only in writing and could not readily be enforced during hypnosis by such relatively ineffective method of communication; and (*b*) one suffering rather from aphonia and inco-ordination of speech movements than from true mutism, who, I suspect, artificially maintained, at least in some degree, his symptoms and the hypnotic state into which he seemed to pass.

A point of greater interest, however, is the further history of the apparent cures. Even in France I had ample evidence to show me that recoveries after hypnosis need not be immediately complete or permanent. One case, for example (not included under [1] in the above table), is perhaps worth recording at length.

Case 8. (Case Number 272).—Rifleman —— aged 30, admitted, four days before my first visit to him at the base, into a casualty clearing station, "having the air of an imbecile, and having wandered about in an aimless fashion not knowing where he is or what he is doing, but having a fair knowledge of recent events." On his way down to the base, he has passed through another casualty clearing station, where he was described as "remaining absolutely speechless and terrified on being questioned."

On examination, I find him in a state of evident terror, but after persuasion he talks (in a faint voice) of his wife, home and previous occupation. He gives the present month as October (actually August), and says that he has been out in France two months (actually twelve). He has no recollection of getting to this hospital. He last remembers himself at the trenches, the scenes in which he describes with obvious emotion. His mind then wanders to his wife, whom he pictures sewing. When not actually terrified, he is in a miserably depressed condition.

Under hypnosis he remembers going into a dug-out after running away from the shells falling in the trenches, but he cannot recall anything later. He can be made to talk in a loud voice, but he wakes spontaneously from hypnosis with little change save an improvement in his headache.

On the following day, when hypnotized, he gives me correctly

the present month and the month of his arrival in France, and can give me the names of two towns, V—— and B——, close to the firing line. On waking he believed himself to be at the latter of these towns. He is again much worried about his wife, mentioning her Christian name and the words "no work." I get him to write a letter to her, the first he has sent her since his illness. It is the ordinary letter of a soldier, containing no reference to his condition.

The next day he is considerably changed in behaviour, and is now active, busily engaged in making the beds in the wards. But he is mute (possibly affected by a case of mutism now in the same ward). Under hypnosis his speech returns and he recalls the immediate cause of his condition, his visit to a horse show at B—— with a man named R——, and his return towards his billet at night when shells began to fall on B—— Railway Station, and something hit his back. He says that he ran to a shed not very far from his billet. He was found hiding in the shed that night, and was brought into "a sort of hospital" in a motor ambulance. After he awakes his power of speech is maintained, but it fails whenever he is asked about the incidents described above. After much effort it returns, but his voice is weak, and again mutism follows when he is pressed about these incidents.

The following morning he wakes speaking in a normal voice. His neighbour says that he nudged him, asking: "Is it me that's talking?" To-day the change in his appearance is still more striking; he is now quite garrulous, and seems a very intelligent, agreeable fellow, whereas before he was depressed and dull. His memory is now far more reliable and complete as to his past history.

At V—— he had been in the trenches up to a week before the onset of his present condition. He is now able to give me his reasons for worrying about his wife. He had only married just before crossing to France, and some months ago he had heard that she was pregnant. He had been troubled with the feeling that she was in money difficulties, and kept thinking of the experience of a friend whose wife had lost her first baby at birth.

Since his return to England this patient has written to me that his recovery has been permanent and, save for occasional headaches, complete. He is now serving in his reserve battalion.

In another case, one of mutism (also excluded from the "apparently complete cures"), hypnosis was followed by a sufficiently complete recovery of speech for the patient to tell me his

regimental number, but an hour later he was found to be again quite mute and "as dismal as ever." In this case, however, re-hypnosis proved futile; he could not even be induced to write during hypnosis, although he had written out his history earlier. In my notes he is reported as being "too dazed and unintelligent during hypnosis, bordering, I fancy, on a hysterical attack (he had had two 'fits' while in the trenches), frequent tremors, and clonus of arms."

Yet another patient completely recovered from his depression and amnesia at the first trial of hypnotic treatment, but was accidentally discharged from hospital on the following day by a medical officer, who, judging from the patient's appearance and in ignorance of his past condition, pronounced him fit for duty. Two days later he was readmitted to hospital in the same stuporose, depressed, lachrymose state as before.

These and other cases showed that hypnosis is of relatively little value when the condition of stupor is too profound, and that any subsequent worry (e.g., over home affairs) or terror (e.g., of scenes of the trenches or of returning to the front) is apt to induce a relapse. Accordingly, nearly all the severer cases of shock which I have seen have, at my advice, been sent to England.

The Value of Hypnotic Treatment.—Despite the slow recovery just recorded in certain cases, I have not the least doubt that the hypnotic treatment which these and other cases received here invariably proved of great assistance in that direction, and would have proved of still greater value if it could have been occasionally repeated later. It may be argued that mutism, rhythmical spasms anæsthesiæ, and similar purely "functional" disturbances disappear after a time without specific treatment. But no one who has witnessed the unfeigned delight with which these patients, on waking from hypnosis, hail their recovery from such disorders can have any hesitation as to the impetus thus given towards a final cure. More especially is this the case in regard to the restoration of lost memories. Enough has been already said here about the striking changes in temperament, thought and behaviour which follow on recovery from the amnesia.

To go further into the subject would involve detailed consideration of the *rationale* of hypnosis in such cases, but this can be more conveniently postponed to a separate communication devoted to the psychology of shell shock generally. Nevertheless, surely this much may be taken for granted here, that the restoration to the normal self of the memories of scenes at one time dominant,

now inhibited, and later tending to find occasional relief in abnormal states of consciousness or in disguised modes of expres-rion—such restoration of past emotional scenes constitutes a first step towards obtaining that volitional control over them which the individual must finally acquire if he is to be healed. Thus the *minimal* value that can be claimed for hypnosis in the treatment of shock cases consists in the preparation and facilitation of the path towards a complete recovery.

ON REAMPUTATIONS.

By R. SCOT SKIRVING, M.B.

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It may seem rather curious that so little has been written on the subject of non-healing stumps with protrusion of bone, a distressing and humiliating condition requiring secondary surgical interference; the reason of this silence is not far to seek. Most surgical literature is the outcome of civil experience, and, in our generation, though there have been bloody wars, there certainly has been none approaching in magnitude to the present conflict with its consequent carnage.

Moreover, the new and cunning ways of death are more far-reaching and shattering in murderousness than the simpler weapons of earlier wars. Hence the incidence of gas gangrene and the widespread comminution of bone, due to the use of new explosives and projectiles, all conditions calling for rapid removal of limbs and free opening up of the parts to allow the greatest possible facility for drainage, often by means of a swift circular amputation, with little or no attempt to form flaps. These, then, are the causes why, in this War, we are becoming quite familiar with stumps which need secondary operations for their cure, and why they explain the scant attention such conditions seem to have received in the surgical literature of the past.

No inconsiderable proportion of the cases I have seen occurred among the repatriated prisoners from Germany. Most of these men were in poor physical condition, and we delayed doing anything radical to their stumps till they had been fed up and had more reparative energy. These cases fell mainly under two types:—

(1) Those where fair efforts at repair existed, but the flaps themselves were obviously inadequate, or where, in a circular amputation without any kind of flap formation, some healing of the cut surface was present, but the bone protruded.

(2) Those in which, with some flap formation, much suppuration existed. The tissues were also in a sodden state, and bare bone, sometimes splintered, stood out of the face of the wound.

In both these classes there was a strong inclination of the skin and fascia to curl right round on itself, and sometimes to conceal

pockets of pus within its embrace. Practically all these patients in the end required surgical interference, for one seldom saw any in which even the most carefully devised extension of the superficial tissues was alone successful in comfortably covering the bone. Extension, as I shall presently point out, was of great help after an operation had made pulling down the skin and fascia a possibility.

As to the operation itself, no two procedures were absolutely alike, and in all cases was certainly a more meticulous affair than any primary removal of a limb.

I may also add here that nearly all the cases requiring assistance were thigh amputations, and it is to these that the following remarks specially apply. On the whole it is better to avoid the use of a tourniquet. The less these poorly nourished tissues have their vascular supply meddled with the better.

In not all of them was there a gross protrusion of bone, but in every one of them the bone was sufficiently unclad to be disagreeably palpable, with, at most, a thin, poorly nourished cicatrical covering, tender, incapable of bearing any kind of pressure, and prone to break down and ulcerate. The edge of the skin and fascia, whether any flaps existed or not, was nearly always infolded on itself, and in some the condition I have already mentioned existed, viz., little collections of pus held in place by the inturning of the superficial parts. These pus collections showed little outward sign of their presence. In some, small abscesses were concealed between the cut ends of the muscles.

It is quite common in ordinary circular amputations performed in civil practice to find this tendency to turn in of the superficial parts, due to their adhesion to the cut muscles, for the non-functionating muscle always contracts and draws the adhering skin upwards and inwards. In these war stumps, the extra factor in leading to this condition is suppuration, which leads to cicatrization and the contraction of muscular tissue. The general condition of these patients was poor. They had irregular temperatures, and the discharges usually contained either streptococci or *Bacillus pyocyaneus*, sometimes both.

As to when to operate. It did not seem good practice, where profuse suppuration was present, to remove more bone, and thereby open up fresh uninfected regions by a premature drastic operation. In such conditions we fed the patient well and drained freely any obvious pockets of pus, using iodine or peroxide of hydrogen as a wash, and dressed the raw surfaces with gauze wrung out of hypertonic salt solution. With some cases continuous baths did

well. When the patient was in better health and the stump fairly clean was the best time to operate. Of course, cases occurred in which, in the act of opening up collections of matter, so great an exposure had to be made that one felt justified in completing the procedure by removing the requisite amount of bone.

I would like to make it very clear that with no flaps at all existing, or only apologies for them, the error of taking too much bone away is far better than removing too little. Further, in fashioning some sort of flaps to cover anew the shortened stump, free lateral or other suitably placed incisions should be made. In these operations one should rely chiefly on skin aud fascia to form flaps, and the most thorough separation of their adherent inturned edges should be carried out, while an assistant vigorously retracts them when the operator next divides what sclerosed muscle is required, probably by a circular cut, and so allows the bone to be made sufficiently bare higher up for the application of the saw.

These may seem trite trifles, but they are really all-important, and when one has done some of these cases one realizes their value. The bone end sometimes presents a large mushroom-like enlargement, mostly fibrous in character. It will be found often that the sawing of the bone is attended with some difficulty. It is, indeed, not easy to retract the stubborn face of the stump with a simple split bandage. It will be found that holding the bone end in the grip of Lane's long powerful lion-jawed forceps, raising the stump to an angle of 45 degrees and at the same time reinforcing the retracting bandage with Lane's long flat bone elevators, used as levers, are measures of great assistance in protecting the soft parts. After the bandage is in position, I fix the points of the long flat elevators into the towelling beneath the limb, and then pull the handles back in lever fashion. This matter of retraction is quite an embarrassment. The best way perhaps to overcome it is to use a large firm metal plate with a suitably sized hole in its middle, through which to project the bone, and with some sort of lateral hand-grips to retract it, and so keep the soft tissues protected, and likewise the hands of the assistant. Probably other people have used such a retractor.

Having removed the bone and secured any divided vessels, which are sometimes difficult to catch by reason of the hard inflammatory tissue in which they are imbedded, and may even include main trunks if one is unlucky, one has to decide whether any suturing is to be done or not. In these cases it is certainly not wise to have much muscular tissue in the flaps. It is, indeed, singularly unattractive in appearance, and its subsequent behaviour, if sepsis

is active, is not conducive to quick healing. It is also obvious that the greatest amount of drainage is obtained by having no sutures at all; yet in some cases a few stitches are allowable. There can hardly be any cases in which a complete suturing, such as one uses in a clean case, is permissible. Such fortunate instances must be rare, for, in these unlucky patients, one cannot look for primary union. In cases where a few sutures are right practice, a couple of properly placed drainage tubes should be inserted, but most of them are best treated, in the first instance, with a light packing of the wound with gauze, gently wrung out of warm hypertonic salt solution. The secondary amputation wounds are often very dirty, and they seem most suitable cases to carry out the technique of continuous irrigation after the fashion suggested by Sir Almroth Wright by siphon bandages.

I may add here that these patients often were admitted with acutely tender stumps, and apparently, in some of them, the precaution of pulling down the nerve trunks and severing them a little way up had been omitted at the primary operation. In the secondary operation it was not always easy to find these ends, in order to make fresh division at a higher level and so keep them out of the way of knocks or pressure.

As to secondary hæmorrhage, it may quite reasonably be expected to occur. On the whole, I am in favour of doing one's best to deal with it by ligature in the wound, and if this fails, then the question of ligature of the main vessel higher up in its continuity can be considered, but it is an unhappy course to be obliged to take, for in these cases one ought to avoid anything like interference with the sources of blood-supply.

In the after-treatment, it is very important to prevent the vicious habit of the newly freed edges again to turn in on themselves. Even where one imagines one has sawn off a liberal amount of bone and made a generous covering for the stump, the tendency is often towards insufficient clothing of it, due to retraction and the recurrent inturning of the unsutured superficial parts. These troubles may be greatly overcome by suitably devised methods of extension, by putting strapping on the flaps if inturning is threatening as soon as the post-operative condition will permit, and then applying extension by a weight and pulley. It is found, as a rule, that these measures are sufficiently efficacious to ensure a sound, serviceable stump. One need not fret greatly if in the end the scar falls across the bone, providing that there is no chronic osteitis, for our artificial limb makers take the pressure off the stump higher up.

Clinical and other Notes.

MODEL HYDROTHERAPEUTIC INSTALLATION FOR SOLDIERS, WITH GROUND PLAN.

By R. FORTESCUE FOX, M.D.Lond., M.R.C.P.Lond.

Description.

This installation is designed to provide the most necessary and valuable methods of hydrotherapeutics for wounded and invalid soldiers. As will be seen from the accompanying ground plan, it is arranged within the compass of a single hut (sixty feet by twenty feet). It is, in fact, a *multum in parvo* of bath treatment. The building is warmed throughout by steam pipes from the same boiler that serves the baths. It is intended that one attendant should take charge of the rooms, with the exception of those for the treatment of disabled limbs. This latter department has a separate access and exit, so as to accommodate large numbers of men without any disturbance of the bath rooms. The installation should be placed in connexion with, or at least conveniently near to, the hospital or buildings where the men are lodged. The pool bath will often be used in the evenings or at nights, and those for whom it is prescribed—for example, men with depression or insomnia—ought to be conveyed after the bath to their beds, with as little possible delay, fatigue and exposure. In many cases it will be found best that they should be wrapped in warm blankets and taken in a wheeled chair from the pool room to the ward.

The *douche room* is fitted with a series of shower baths and a proper nozzle douche, with varying pressure and temperature, a needle bath, and a screen for the use of local douches to the limbs. In the adjoining passages are *cubicles* for dressing and undressing, and a closet for *linen*, heated by steam pipes. An ample provision of hot bathing sheets and towels greatly enhances the value of the baths, especially in the cold season.

The *tubs* (three) for brine and effervescing baths, etc., are best served in a separate room.

The *pool* is designed to give long-continued baths at a constant temperate heat. The pool chamber adjoins the boiler house, has no external walls, and is well supplied with steam radiators. By this means the temperature is kept at about 60° F. day and night. This bath is designed entirely for sedative treatments, and is therefore as quiet and undisturbed as possible. A waterproof curtain divides the bath from the vestibule (for undressing), and serves to minimize draughts. The pool

(eight feet by eight feet) is of such a size that ten men can be comfortably seated in it. The water is flowing and constantly renewed, and is maintained at a uniform temperature (93° F. to 95° F.), by means of a calorifier fitted with a thermostatic valve.

The *department for disabled limbs* consists of: (1) A room for hyperthermal local applications: "whirl baths" (*eau courante*), hot air and radiation baths, etc. (2) A room fitted with tables for massage and manipulation and simple apparatus for mobilization of the joints.

The *boiler house* outside the hut supplies hot water at the required temperatures for all the baths, and steam heating for the building.

Indications and Directions.

The above installation is designed to provide :—

(*a*) *General treatment :* (1) Tonic; (2) sedative; and

(*b*) *Local treatment* for disabled limbs.

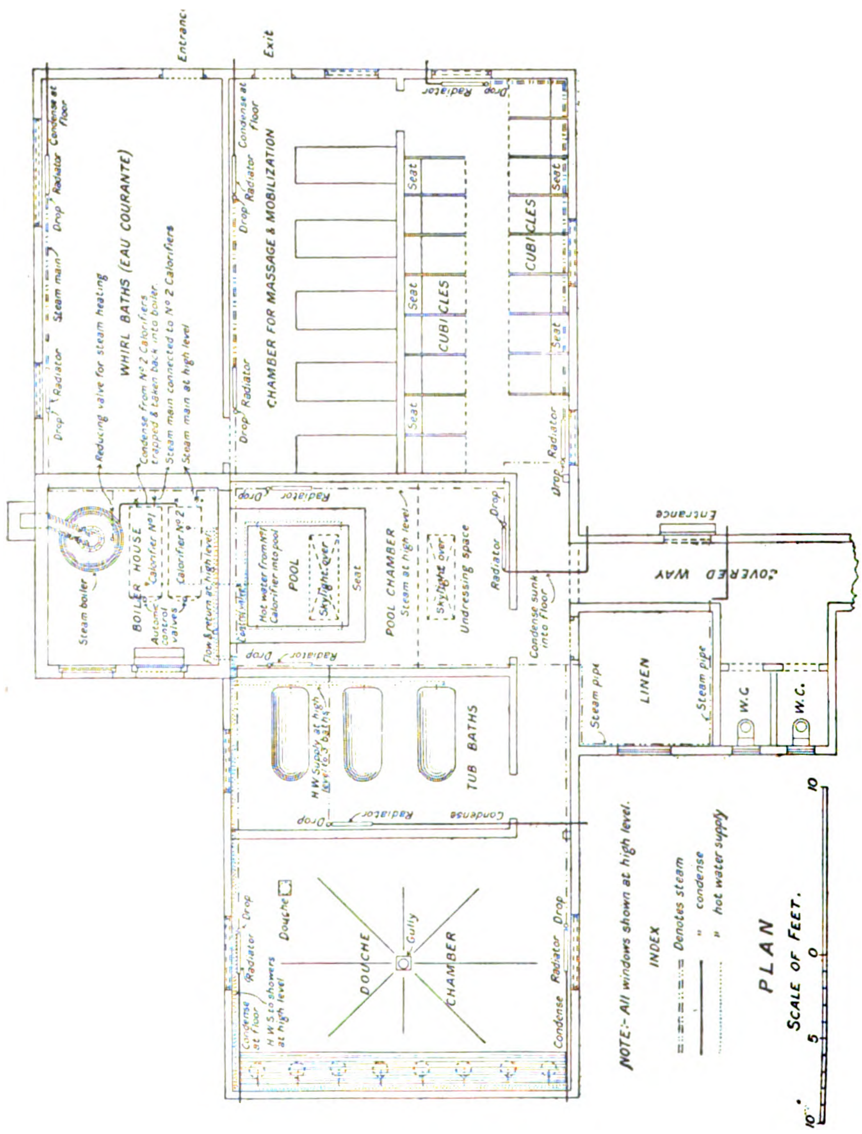
Tonic Treatments.

A variety of tonic treatments for convalescent soldiers may be given in the large and commodious douche room. Brief and refreshing *shower baths*, beginning warm (95° F. to 100° F.), and finishing cold after two minutes, can be given daily to large numbers of men. Provision is made for operating nine such baths simultaneously. They may be freely ordered as a daily treatment for men out of condition, in whom the circulation is slow and feeble, and nervous reactions are sluggish and depressed—neuro-vascular atony. Cold after heat, in this form, stimulates oxidation, and so increases bodily warmth, invigorates the heart and circulation, and powerfully stimulates the nerve centres. Like other tonic baths cold showers are contra-indicated when the heart's action is too frequent, and when the nervous reactions are exaggerated neuro-vascular irritation.

A more powerful tonic bath is the *nozzle douche*, the stimulant effect of which can be heightened by increasing the pressure of the water. The douche should always begin warm, and finish after one, or at most two minutes, as cold as can be comfortably borne. For very atonic subjects two jets (at 100° F. and cold, respectively) can be used simultaneously. By this means rapid alternations of temperature are applied to the limbs and spine. The alternating douche is indicated for chronic neuralgias and for atonic and spinal neurasthenia, also for mental depression and malingering.

Tonic and Sedative.

Tub baths are commonly given at 98° F. (blood heat), with a duration of ten to fifteen minutes. Where a long-continued bath (half an hour to two hours or more) is desired, the temperature should be lower (94° F.), and regulated by the attendant. Such continued baths have been found beneficial, *inter alia*, for imperfectly healed and painful wounds.

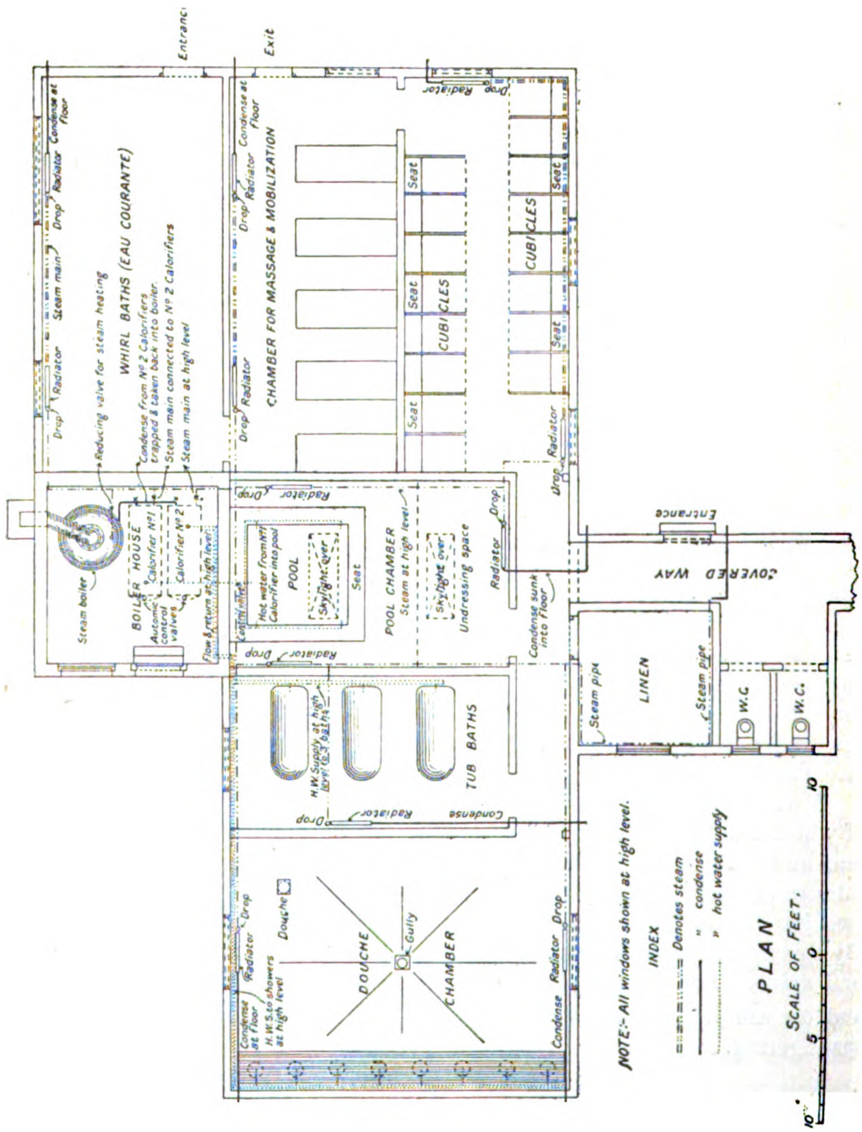

Entrance
Exit
WHIRL BATHS (EAU COURANTE)
Reducing valve for steam heating
Condense from No 2 Calorifiers trapped & taken back into boiler
Steam main connected to No 2 Calorifiers
Steam main at high level
CHAMBER FOR MASSAGE & MOBILIZATION
CUBICLES
Seat
BOILER HOUSE
Steam boiler
Calorifier No 1
Calorifier No 2
POOL
POOL CHAMBER
Steam at high level
Undressing space
Skylight over
TUB BATHS
DOUCHE CHAMBER
Douche
Gully
LINEN
Steam pipe
W.C.
W.C.
COVERED WAY
Radiator
Drop
Condense
NOTE:- All windows shown at high level.
INDEX
Denotes steam
" condense
" hot water supply
PLAN
SCALE OF FEET.
10
5
0
10

Very brief *hyperthermal baths* (105° F. to 115° F.) may also be given in this room, in cases of sluggish circulation, "fatigue fever" and "muscular rheumatism." The first effect of very hot baths is to stimulate the heart and to dilate the superficial arterioles. They restore the normal course of the circulation in many painful conditions of vascular stasis, and so sweep away the accumulation of waste products. It is of great importance not to prolong the duration of a hyperthermal bath beyond two, or at most three minutes, otherwise the first stimulant effect of heat will be followed by debility, and the good effects be lost. Moreover, all hot and very hot baths should be terminated by a momentary affusion with cold water. For this purpose a small hand bucket should be filled at the cold tap, and poured over the chest and spine of the patient before leaving the bath. Brine baths and effervescing (carbonated) baths are also given in this room, the former in cases of muscular and tendinous "rheumatism," and the latter for cardiac debility.

Sedative Baths, Pool Chamber.—This bath will be found helpful in all conditions of neuro-vascular irritation, from the psychical level downwards. The patient is seated in flowing water at a temperature nearly equal to that of the skin. The sedative effect is proportional to the duration of the bath, which may be extended to several hours. These prolonged and "sub-thermal" baths are especially indicated in cases of mental disturbance, with depression and irritability, due to exhaustion of the nerve centres; and are also used for insomnia and restlessness; and for shock, peripheral neuritis and neuralgia. The massive equable impression of the water, at a constant temperature, allays irritation, slows the heart and favours sleep.

Local Treatment for Limbs disabled by Wounds.

This may be described as a combined treatment by heat, moisture, manipulation and movement, similar to that employed at the Hospital for the Physical Treatment of Disabled Soldiers at the Grand Palais in Paris (see this Journal for October last, and the *Lancet* of February 5, 1916). In the first chamber are installed the *whirl baths* for the arm and leg respectively. In them the limb is subjected to a rotatory current of water, rising in temperature from 110° F. to 115° F., or 120° F., or even higher, according to individual toleration (*Balnéation à l'eau courante*). The duration of these baths, which are usually given daily, is from fifteen to thirty minutes. Such applications greatly increase the arterial and lymph circulation in the injured part ,promote the absorption of effusions, and accelerate the retrogression of inflamed tissues. They also have a marked sedative effect in relieving pain and muscular spasm. They are consequently used *inter alia* for trophic lesions resulting from prolonged suppuration, chronic œdemas, swellings of the peri-articular tissues, fractures of the articular ends of the bone and painful and adherent


Entrance
Exit
WHIRL BATHS (EAU COURANTE)
Reducing valve for steam heating
Condense from Nº 2 Calorifiers trapped & taken back into boiler.
Steam main connected to Nº 2 Calorifiers
Steam main at high level
Steam main
CHAMBER FOR MASSAGE & MOBILIZATION
CUBICLES
Seat
Steam boiler
BOILER HOUSE
Calorifier Nº1
Calorifier Nº2
Automatic control valves
Flow & return at high level
POOL
Skylight over
POOL CHAMBER
Steam at high level
Undressing space
Condense sunk into floor
COVERED WAY
LINEN
Steam pipe
W.C.
W.C.
TUB BATHS
H.W. Supply at high level to baths
DOUCHE CHAMBER
Gully
Douche
H.W.S. to showers at high level
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cicatrices. Hyperthermal whirl baths may be given with advantage in every case as a preparation for massage and movements, which are by their use rendered easier and less painful. Similar baths at a lower temperature promote the cleansing and healing of wounds and the separation of dead tissue.

Following these applications of heat, the limbs are submitted in a second room to massage and mobilization. In this room simple mechanical apparatus may be with advantage installed.

Records.

The physical methods employed with these various baths, both general and local, and the results obtained, may be conveniently recorded on a card resembling that used at the Grand Palais Hospital, which has been prepared by a committee of the Section of Balneology and Climatology of the Royal Society of Medicine. These cards have been approved by the Medical Research Committee, and will form part of the data for the medical history of the War. They will be supplied on behalf of the above committee by the printers, Messrs. Adlard and Son, 76, Newgate Street, E.C.

Note.—A "continuous bathing installation," by means of a pool, as well as tonic baths and rooms for the local treatment of disabled limbs, similar to those above described, have now been erected at the Command Depot at Tipperary.

A complete installation of sedative, tonic and local baths, according to the above plans, has also been approved for the Command Depot at Heaton Park.

TRENCH FEET.[1]

By Lieutenant-Colonel B. SOLTAU.
Royal Army Medical Corps.

In the winter of 1914-15, a number of cases were admitted to the field ambulance with which I was serving, suffering from what was at first spoken of as "frost-bite," but which is now better described as "trench feet" or "chilled feet."

I can only, in this paper, present the condition as we saw it in the first stages, leaving to others to recount subsequent progress and the treatment adopted at the base.

As to the pathology of the condition, the first point noticed was the marked similarity to Raynaud's disease. The two varieties of that disease, the congested and the white, were exactly reproduced. The majority of the cases resembled the congested type, but a certain proportion had no swelling, and exhibited only a dead white foot. This suggested that the pathological condition underlying the affection was a

[1] Read before the Medical Society of the III Corps, British Forces, France.

vasomotor one. There was some evidence that the white numb condition was only a precursor of the congested one, in that cases admitted in that condition were seen to pass to that of œdema and discoloration whilst in hospital. This would suggest that the whole condition is one which commences as a vasomotor paresis passing on to paralysis, with consequent hæmostasis, œdema and ultimate gangrene. The question of a bacterial factor was raised, and at a neighbouring casualty clearing station cultivations were made. Beyond hearing that a streptococcus was isolated in pure culture, both from superficial blebs and from deep punctures, I did not obtain any information as to results. One would be inclined to suspect, however, that the bacterial invasion was quite a secondary one, that the streptococcus was one of the ordinary epidermal growths, such as have been proved to have pathogenic action on damaged tissues, and that the essential pathological change is primarily a vasomotor one, affecting the vascular terminals first of all.

The difficulty that has to be met, if accepting this theory, is the neuritis which is often seen extending far above the initial and obvious lesions. It appears to be an ascending neuritis, in that I have seen it travel upwards, as evidenced by spreading anæsthesia, which affected ultimately the whole of the anterior tibial skin distribution. In one case, particularly, which comes to mind, the anæsthesia spread upwards day by day.

The main etiological factors in the production of the affection are cold and wet in combination. Pressure is an aggravating factor, but probably not a cause. A wet trench is therefore, in the winter, an ideal locality for developing "trench" feet. No cases arose during the summer, though in the summer rains some of our lines were very wet. The cold wet, leading to rapid heat loss, probably causes first a local vaso-constriction leading to defective circulation through the feet, and thence to vasomotor paresis. Pressure, by hampering an already impeded circulation, will increase the trouble, and any local causes of constriction will act in the same way.

The onset is gradual, and the most usual history to obtain is that the man felt his feet getting colder and colder, and ultimately lost all feeling in them. Pain, beyond the discomfort associated with cold feet, was not complained of at first. Later, as the feet began to swell, there was pain round the ankles, occasionally extending up the calves. If the man at this time took off his boots the feet swelled immediately, and it was impossible to replace the boot. If the boots had not been taken off, the man could usually hobble along with difficulty.

The appearance on admission to hospital was in the majority of cases that of swollen feet in all stages of lividity, from a bright blush to a dead black gangrenous appearance. The feet were swollen to a great size, the skin was covered with bullous eruptions, containing a blood-stained fluid, and to the touch the feet were quite cold. The discoloration was often

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quite sharply demarcated at the mid-tarsal joint, suggesting that it was the part of the foot immobilized by the boot toe that suffered most, and that where circulation was kept going by the movement of the ankle the trouble was greatly mitigated. In the milder cases there was œdema over the tarsus, with little discoloration. Often the only colour change was a bright pink flush showing on the ball of the great toe and the tips of the toes. In the other type of case the foot was dead white and stone cold, and there was no feeling in it. In both types there was an anæsthesia of patchy distribution, but mainly over the final distribution of the anterior tibial nerve.

From our inadequate experience little could be formulated as to prognosis. The appearances of the bad cases suggested that gangrene and loss of the greater part of the feet must inevitably follow, but I believe that this rarely occurred, and that superficial sloughing was the more common end, only a small amount of actual tissue loss supervening.

In either type it is safe to prognose that recovery will be tedious. The bad cases were evacuated as quickly as possible, and we heard nothing more of them. The mild cases were kept. Even in such cases, many who at first appeared to have the mildest affection with no swelling often disappointed us. Pain, increased at night, leading to disturbed rest, and exacerbated by walking, persisted so long that ultimately many had to be evacuated. Evidently the nerve lesion was more pronounced and more lasting than the first appearance suggested as likely.

The patients whose feet were in the swollen and apparently gangrenous condition complained of little. They were for the most part free from pain. It was the other type of case that suffered most. Long after the circulation had been apparently restored, the feet being warm and of healthy appearance, the pain, of a true neuritic type, appeared to be most acute. There was also great tenderness of the soles of the feet, so that walking and even massage could barely be tolerated. It was especially severe at night, and it was no uncommon thing to find men sitting up crying with pain, at all hours of the night. Warmth exacerbated the pain, and the men invariably preferred to sleep with their feet uncovered by blankets. The nocturnal character of the pain, and the fact that it is aggravated by warmth, are two most useful points to remember in dealing with possible malingering. A quiet round of the wards at 1 a.m., to notice if the men are asleep and if they have their feet covered, will often help to form an opinion.

Passing now to treatment, unhappily not a very cheering point. For the bad cases nothing could be done but elevation of the feet, which were well powdered with boric acid and wrapped in cotton wool, changed twice daily.

Where there was little swelling, massage twice daily, when it could be borne, was performed, the patient being taught to rub his own feet. Having no trained masseurs, this was a strenuous piece of work, until we

had taught the elements of rubbing to our men, and it taxed the officers severely. After the rubbing the feet were wrapped in wool and elevated until all swelling had gone.

The wards were kept well warmed, but men were forbidden to sit round the fire. Warm footbaths were used as soon as it was considered safe in each case as a preliminary to the rubbing. Painting with iodine was tried in many of the neuritic cases and appeared to relieve in some cases.

For the pain, morphia by the mouth was the only satisfactory drug. Aspirin, salicylates and belladonna all failed to give any real relief. Convalescents were encouraged to move about, and we tried to institute a little foot exercise drill, but without much success. At this time we had sometimes over four hundred cases in, which taxed the capacity of the unit to the full. It will be obvious that our attention must be turned to preventive measures, and the various circulars to this end which have been issued are all based on last winter's experience.

Especial attention must be paid to men who have suffered before, as there is reason to suspect that a prolonged if not permanent injury has been done to the vasomotor supply of the feet, which will tend to make recurrences frequent.

The ideal preventive measure is to have dry trenches, and as far as possible the responsible authorities are studying to secure this. Further, the communication avenue must be kept dry also, so that men shall not arrive for the trench tour with wet feet. An outgoing battalion might well have the responsibility placed on it of seeing that the avenue down which relief will come is pumped as dry as practicable on the day of change.

As a preliminary to entering the trenches, an elaborate ritual has been laid down, including boot and foot inspection and the oiling of the feet. It is an order that the boots shall be roomy. This allows for the shrinking of the wet leather and the slight swelling of the foot which must follow the long standing in a comparatively motionless condition. It is a small point to remember, that the left boot should be fitted rather than the right, owing to the fact that in the majority of men the left foot is the larger of the two. The boots must be well greased at intervals, to keep the leather supple and to prevent its becoming waterlogged. The junction of sole and upper requires special attention in order to prevent the stitching rotting, as also the seams. Men should be instructed not to lace their boots too tightly, nor to wind their putties tightly, as in both these ways impeding the circulation is aided. The oiling of the feet is not a fetish, but is based on sound experiments, conducted as follows:—

A healthy man was placed with his feet immersed in cold water up to the calves. The immersion was continued for a fixed period, and the heat loss so sustained was estimated exactly, both by surface temperature, deep temperature and water temperature readings. On the following

day a similar experiment was carried out, the man having his feet well covered with whale oil, and the heat loss was found to be reduced by fifty per cent. The oiling must be done carefully, and the oil well rubbed in. It is not necessary to use a lot of oil, only a thin film being needed, In this way, the complaint that oil makes the feet cold can be avoided. We have tried to overcome the complaint by mixing mustard in the oil, but without much success. The essential oil of mustard is needed to make a good mixture, and this is not possible to obtain in large quantities.

A grease is also issued, which has the advantage of needing rubbing to be applied, and so by the friction assisting the circulation. I do not know what preparation the men prefer, but as a trench issue I am inclined to favour the use of oil. In those rare tactical situations where men cannot take off their boots, a little oil can be poured into the top of the boot, and will diffuse over the foot.

When in trenches constant care of the feet is necessary. Everybody now realizes the importance of the order as to daily removal of boots. In this way congestion is lessened, opportunity is afforded for friction and re-greasing, and dry socks can be put on. The men must learn the value of clean dry socks and be taught to carry their spare pairs in a dry place.

Exercise in the trenches is not easy to carry out, but something can be done to help. For instance, in one division, tarpaulins were provided on which the men could lie down and do overhead feet exercises. Men should also be encouraged to stamp their feet, move their toes about inside their boots, etc.

It is not a sound practice to supply hot water for feet washing in the trenches. There is danger from sudden reaction, leading to swelling of the foot and subsequent constriction on replacing the boot. In very cold but dry weather sandbags pulled over the feet, stuffed lightly with straw, and secured loosely round the leg below the knees, were found a useful aid in keeping the feet warm. On the return from the trench tour, as soon as the rest billets are reached, the feet must be again attended to.

Washing should be encouraged, and lukewarm water should be provided. It is an advantage to use a little mustard in this, about half an ounce to a gallon of water. After drying, fresh socks should be put on.

It will help also if some system of drying the boots can be devised and carried out. The old hunting plan of filling the boots with hot dry oats is a excellent one, *when* the oats are available.

Such is the generally accepted routine which, though it will not entirely prevent the occurrence of trench feet, will certainly go far to secure that suffering and loss from this cause is lessened during the winter.

ULCERO-MEMBRANOUS STOMATITIS AND GINGIVITIS AMONG TROOPS ON ACTIVE SERVICE.

By Captain F. B. BOWMAN.
Canadian Army Medical Corps.

The attention of medical officers of units and of military hospitals, both at the seat of war and in Great Britain, is called to a freely communicable disease which, while of a minor nature in so far as it rarely has a fatal issue, is nevertheless of serious import in that it materially lowers the health and effectiveness of those attacked.

The Disease.

Within the last few years considerable attention has been attracted to the condition of pyorrhœa alveolaris, a condition in which small pockets of pus form between the tooth and the gum, so that pressure upon the gum just below where this abuts upon the tooth leads to the discharge of a drop of pus. American observers were the first to show that this condition is frequently associated with the presence in the pus and in the tissues at the base of the pus pocket of amœbæ somewhat resembling those found in amœbic dysentery, and like them, as demonstrated by Bass, acted on specifically by emetine. Uncomplicated cases of this condition can be cured by the exhibition of this drug, but not all cases of so-called pyorrhœa alveolaris show themselves equally affected by the treatment.

An examination of cases coming from the Front and from troops in the Shorncliffe area has shown that while these uncomplicated cases present themselves in a very large number of cases clinically resembling ordinary pyorrhœa, the most striking feature revealed upon examination of smears made from the pus is the presence of what are known as Vincent's organisms in large, not to say preponderating, numbers. In these cases amœbæ may or may not be recognized. Further study has shown that where these Vincent's organisms are present, unlike what happens in simple pyorrhœa alveolaris, there is a distinct liability to a spreading infection of the gums, and in the more severe cases this spreading ulcero-membranous gingivitis is the striking feature overshadowing the attendant alveolar pyorrhœa. This ulcero-membranous gingivitis further is seen to be but one expression of a form of stomatitis which may affect the tonsils (and this very frequently), the mucous surface of the cheeks, the tongue or the gums. In all these situations ulcers are to be found. The ulcers tend to spread laterally save in the tonsils, where they burrow deeply into the tissues. They are covered by a white, friable membrane easily removed, and then leaving a bleeding surface beneath. This membrane is different from that found in diphtheria, which is tough and easily comes away intact. The lesions

may suggest syphilis, and indeed this Vincent's angina[1] may be superimposed upon a syphilitic infection of the mouth and throat; but in uncomplicated cases of the condition the Wassermann reaction has always been found negative.

The condition of the gums in advanced cases strongly suggests scurvy. The gums bleed easily, are injected, retracted from the teeth and spongy-looking. The teeth are apt to become loose and are often tender when tapped by a metallic instrument. In many cases they have become so tender that none but the softest of food can be masticated, and for weeks the men are unable to take the ordinary rations; as a consequence they become seriously run down. The breath becomes extremely fœtid, and the patients complain of a foul taste in their mouths.

There is always more or less glandular enlargement, the submaxillary and sublingual glands being most often affected. Although several authorities speak of a rise of temperature to 105° F. or higher, in the cases thus far examined from the British troops the temperature has varied between the normal and 102° F. at the highest. Accompanying this constitutional disturbance is in general well-marked, with lassitude and lack of "go." The most serious constitutional symptom, and one always present when the teeth and gums are affected, is severe depression.

What may be regarded as the acute stage of this disease is seen in noma, in which the necrotic tissue shows a dense massing of these organisms of Vincent.

We have thus the following conditions found associated with the presence of masses of the organisms in question: (1) Some (complicated) cases of pyorrhœa alveolaris; (2) ulcero-membranous tonsilitis, glossitis, and gingivitis; (3) noma. The term Vincent's angina, in England at least, is generally understood to refer to a particular form of tonsilitis. Ulcero-membranous stomatitis appears thus to be the more satisfactory designation, unless we elect to speak simply of Vincent's disease.

The condition is clearly communicable. Chamberlain has reported a hand infection due to a bite by an infected person: Todd, the infection of a pathologist exposed to the disease in an insane asylum. The use in common of drinking cups, dishes, etc., has been shown to lead to the spread of the disease. In Captain Bowman's series a small collection of cases was traced to a dentist who had treated a severe gingivitis for pyorrhœa, and the same day had operated upon the mouths of three other men. All three contracted the disease, and were shown by stained smears to be infected with Vincent's organisms. In another case, while the disease had been unknown in two successive battalions that had

[1] So called after Vincent, the French bacteriologist, who clearly laid down (in 1898 and 1905) the relationship between these organisms and ulcero-membranous tonsilitis and stomatitis.

occupied certain quarters in France, a third battalion using these quarters exhibited no less than fifty cases of the condition. The close association of troops either in camp or in the trenches using the same utensils appears to favour the spread of the condition.

VINCENT'S ORGANISMS—BACILLUS FUSIFORMIS AND SPIROCHÆTES.

If in these cases, by means of a sterile swab, a small portion of membrane or exudate is removed from the mouth, and rubbed up in a little warm 0·85 per cent saline solution on a slide, an examination with a dark-ground illuminator shows in all instances the presence both of spirochætes and of characteristic fusiform bacilli. Both forms are motile; the fusiform bacillus passes backwards and forwards with a tumbling motion, and not steadily, as is the case with the flagellate bacilli, such as *B. typhosus* and *B. coli*. If smears be made and stained, the clearest picture of these organisms is given by Giemsa's stain. Successful results are obtained with plain methylene blue or Loeffler's solution, which show the fusiform bacilli and the spirochætes distinctly. The bacilli are not stained evenly, but are usually barred, with an occasional granule deeply stained situated anywhere in the organism. The bacillary forms are from 12 to 15μ, long, and vary in width from 1 to 5. The spirochætes are very slender and delicate organisms. The number of convolutions varies from 5 to 12, the usual number is 9. No membrane can be seen. In stained smears these spirochætes have no definite relation to the fusiform bacilli present in the same specimen; they are found sometimes in large bundles, sometimes singly.

This Vincent's spirochæte is usually differentiated from *Spirochæta dentium*, which has usually no more than five convolutions, and from the *Treponema pallidum* of syphilis, which has between five and twenty-five, which also stains faintly and with difficulty. *Spirochæta refrigens* is much coarser and has broad sections.

The organism has been cultivated by Tunnicliff, who states that she was able to obtain distinct transition from the bacillary to the spirochætal form. Bowman has obtained cultures by taking some of the exudate upon a sterile swab, and rubbing this up with hydrocele or ascitic fluid, inoculating the emulsion into a deep tube of peptone broth. This tube is corked with a sterile rubber stopper, which has passing through it a capillary tube. The test-tube is filled quite full of the medium, and, on pushing in the stopper, this rises into the capillary, which is immediately sealed off, thus affording a strictly anaerobic culture medium. The growth appears in a few days as a faint cloud above the sterile tissue in the tube. Usually this affords a great preponderance of fusiform bacilli; a very foul odour is given off from the medium, closely resembling that exhaled from the mouths of those affected. Starch-ascitic fluid cultures prepared according to Rosenow's method of deep tubes are also successful. In

fact, any ordinary culture medium containing serum or ascitic fluid will afford growths of the organism under anaerobic conditions.

TREATMENT.

As already noted in pyorrhœa alveolaris, where the amœba is demonstrable, local treatment with emetine frequently brings about cure; but emetine is of no value in the more widespread conditions of ulcero-membranous stomatitis and gingivitis, and Vincent's angina. For these latter conditions many forms of treatment have been recommended. Trichloracetic acid, carbolic acid, silver nitrate, iodine and hydrogen peroxide have all been used with some success. It is to be noted that we are dealing with the presence of a spirochæte, and arsenic in some form, from its well-known effect upon spirochætes, would appear to be the ideal application. Of all arsenic compounds salvarsan is the least toxic, and would thus seem to be indicated, and as a matter of fact salvarsan has a marked effect on the condition, even when used as a mouth wash. Its use among troops, however, is prohibited, both from its cost and on account of the instability of its solutions. This close association between pyorrhœa, with its amœbæ, and ulcero-membranous stomatitis, suggested a combination of ipecacuanha or its alkaloid and Fowler's solution. These are compatible, and the following treatment has been found to have remarkably rapid and favourable results. Take of

Vinum ipecacuanhæ	½ ʒ
Glycerinum	1 ʒ
Liquor arsenicalis, ad.	1 ℥

M. Fiat mist. Sig.: To be used as a mouth wash. Do not swallow.
Label POISON.

Where the gums only are affected the solution can be carefully applied to the gums and pockets around the teeth, after cleansing away the pus. Use a small applicator. Where there is ulceration elsewhere in the mouth or throat, the ulcer is to be thoroughly wiped out twice every day with the above solution. All patients, whether or not the gums be infected, are instructed to drop ten or fifteen drops of the mixture on to a tooth-brush twice a day and to vigorously brush the teeth and gums.

RECOMMENDATIONS.

It is recommended that medical officers carefully examine the mouths of men under them for evidence of this condition, and that where it is found a full test of the method and treatment here noted be given. At Shorncliffe the treatment has been most successful, slight cases showing rapid healing, and even in severe cases in seventy-two hours there is observed a marked change for the better. The gums clean up, the membrane disappears from the ulcers, the foul smell in the mouth is no longer noticeable, teeth which were loose become firm, and men who for

weeks have been unable to take solid food are able to masticate with comfort.

Lastly, the depression disappears and the men become fit and ready for active duty.

This subject is brought to the notice of medical officers not merely for their information, but in order that they may investigate and record how frequent is the condition and to what extent they are able to confirm the success thus far found to attend the treatment here described.

THE AFTER-TREATMENT OF AMPUTATION STUMPS.

By Captain C. W. G. BRYAN.
Royal Army Medical Corps.

In amputations performed for septic gunshot wounds it is usually necessary to leave the wound unsutured, and often a rapid operation has to be carried out with flaps insufficient to cover the end of the bone, which must be excised at a later date.

At the exhibition of fracture apparatus given at The Royal Society of Medicine in October last[1], Sir George Makins showed a short Thomas's knee splint for exerting traction on the soft parts of an amputation stump. I have been using recently a simple and easily made arrangement which has the advantage of permitting the wound to be dressed without relaxation of the pull on the soft parts, a continual powerful extension of skin and muscles being kept up.

A ring of aluminium, having a diameter of eighteen inches, is made from a length of the splinting supplied in the regulation field fracture box. All round the amputation stump, from the joint above to about an inch from the edges of the wound, longitudinal strips of two-inch adhesive strapping are applied; these strips are prolonged about twelve inches beyond the end of the stump and attached to the aluminium ring. The ring is then suspended by three pieces of cord, tied to it equidistant from one another, the cords passing through pulleys hooked to a Balkan splint, to which an extra bar of wood has been bolted (figs. 1 and 2).

The free ends of the cords are tied together and one or more weights are hooked on, at or near the point of junction, so adjusted that the tension on the three cords is approximately equal. For a thigh amputation a weight of about eight pounds is used, and for the arm about five pounds suffices. For an amputation stump of the lower extremity the foot of the bed is raised on blocks to provide counter-extension.

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[1] *British Medical Journal*, October 16, 1915, p. 574.

The wound is accessible for dressing through the open ring, the pull on the soft parts being kept up uninterruptedly.

The method which I have described is made use of as soon as the acute inflammation of the wound has subsided. If long flaps have been fashioned they are pulled down by the appliance and their edges approximated. If it has not been possible to form long flaps the bone may not be covered, but the soft parts are kept from retraction until such time as a secondary removal of bone can be carried out.

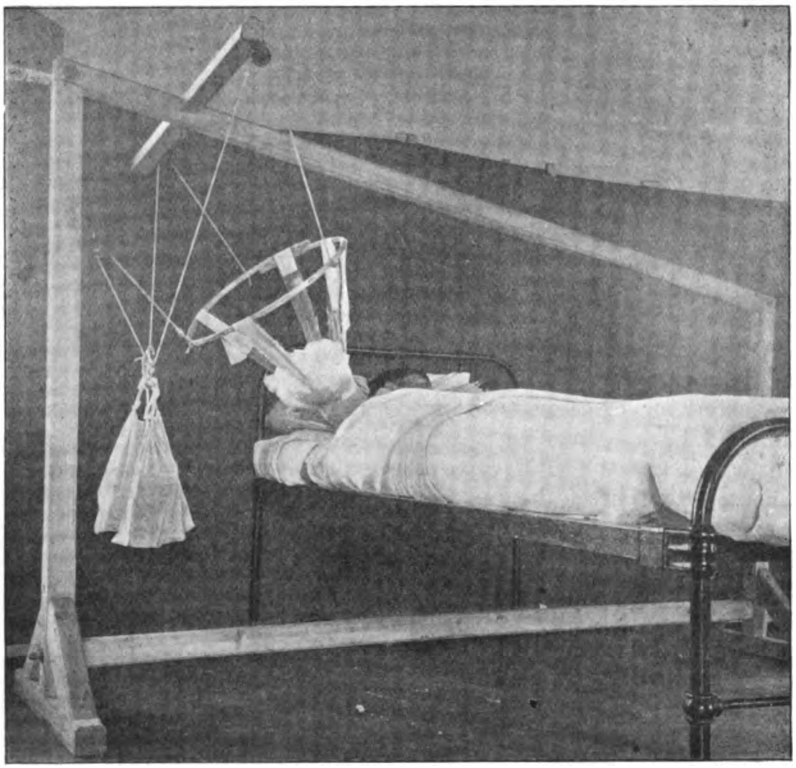

FIG. 1.—The extension apparatus applied to a stump after amputation through the upper third of the arm.

When the wound is granulating and sufficiently healthy to permit of its partial closure, the soft parts are dissected up from the bone and the necessary amount of the latter is removed; in some cases the skin edges can be approximated by a few mattress sutures, free drainage being provided. The extension is then reapplied and kept up until the wound is completely healed.

If at the first operation it is possible to suture the amputation

wound, it is advantageous to take the tension off the flaps in the way that I have described, and for the same purpose it may be of use for the amputations of civil practice.

The appliance allows the patient free movement and encourages mobility of the joint above; if necessary the position of the Balkan splint is moved from day to day for this purpose.

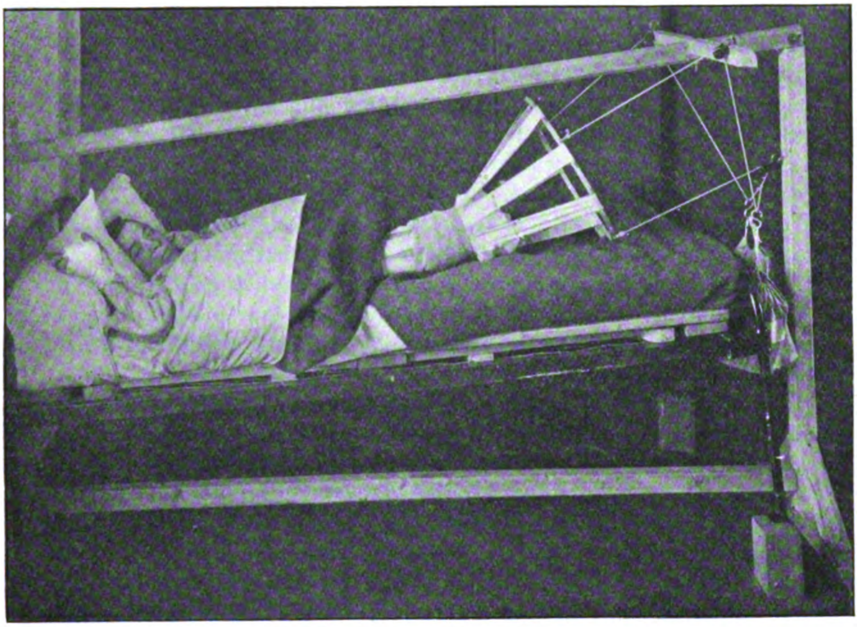

FIG. 2.—The extension apparatus applied to an amputation stump of the thigh.

I have used the aluminium ring attached to a Thomas's ring, but the method of extension by weight and pulley gives more powerful and continuous traction than a fixed extension, it allows more movement in the joint above, it adjusts itself to the patient's movements in bed and he is more comfortable and more easily nursed.

Report.

FULHAM MILITARY HOSPITAL.

THE fifth clinical evening was held on Tuesday, January 25, 1916, Major Parsons, commanding officer, in the Chair.

By way of illustration of the value of putting up fractures under X-ray illumination, Major Parsons showed the skiagrams of a case in which the left humerus was fractured by a gun-shot wound on September 9, 1915. A sequestrum was removed on October 18, and firm union in a good position was secured. On December 28, the patient had a fall and re-fractured the arm. It was put up in a Jones's splint for fractured humerus. On subsequent examination the position was found to be very bad. By manipulation under X-ray illumination a good position was easily attained by the insertion of a large pad between the lower end of the arm and the chest and by firm bandaging, and a useful arm in good position resulted.

Lieutenant Gray then showed the skiagrams of a somewhat similar case, in which Jones's splint failed to keep the lower fragment of the humerus from projecting forwards and inwards as revealed by the X-rays. The Jones's splint was replaced by lateral straight splints, and union with a perfectly satisfactory arm resulted.

Captain Lee showed a case of extensive pulmonary disease in which the physical signs were consistent with the diagnosis of tuberculosis, which had been made before admission, but no tuberculosis was found at repeated examinations. Skiagrams showed extensive fibrosis, affecting especially the bases, radiating thither from the roots of the lungs and leaving the apices comparatively clear; a Wassermann test was very strongly positive, a syphilitic laryngitis was present, and on these facts a diagnosis of syphilis of the lung had been arrived at. Dr. Florence Stoney, radiographer to the Hospital, pointed out that the position of the fibrosis and the horizontal position of the heart were more consistent with a diagnosis of syphilis of the lung than of tuberculosis.

Mr. Dainty then showed a case of pulmonary disease for consideration along with the previous case. There was a history of long-standing disease, with signs on admission of involvement of the right apex, but no tubercle bacilli were found on repeated examinations. Dr. Stoney, in commenting on the skiagram, pointed out that in this case the conditions were not wholly those of tuberculosis. The heart was horizontally placed and there was an absence of the diffuse mottling usually associated with tuberculosis. There was a general expression of opinion that the case required further investigation with a view to excluding syphilis.

Dr. Carnegie Dickson, pathologist, said that Professor Greenfield had long taught that syphilis was a common cause of fibrosis of the lung. In post-mortem examinations the two diseases were not infrequently associated, and tuberculosis was a not infrequent termination of syphilitic disease, the syphilitic lung being peculiarly liable to other infections. He was inclined to think both these cases were instances of syphilis, which had given rise to a fibrotic process extending from the root of the lungs, more especially outwards and downwards in the lower lobes.

Dr. Kinnier Wilson then showed a series of interesting nerve cases. In the first, a man received on June 7, 1915, a severe blow on the back of the head from a crane and remained unconscious for some hours. He was immediately paralysed in all his limbs and had retention. There had been gradual improvement since, and at present the chief signs are: Some kyphosis of the cervical spine, a relative diminution of sensation on the left side of the body up to the clavicle, spasticity in all four limbs, exaggeration of the scapulo-humeral reflexes on both sides and of all the deep reflexes of the arms and legs, with ankle clonus and an extensor response. The diagnosis lay between a hæmatomyelia and a hæmatorachis at about the level of the third cervical vertebra. X-ray examination showed no evidence of fracture dislocation. He was inclined to think a hæmatomyelia the more probable.

The second was that of a man who had been under treatment at the National Hospital for acute cerebrospinal syphilis ten years ago. He was at that time extremely ill with mental confusion, right hemiplegia, dysarthria, etc., but made an excellent recovery and had been at work for years. At Christmas, 1915, he got tired owing to special pressure of work, and some weakness of the right leg reappeared. At present he showed an Argyll-Robertson pupil and absence of the knee and Achilles jerks, in fact signs of early tabes. In the first illness he had unmistakably syphilitic disease of the cerebral vessels, now equally unmistakably of the nerve parenchyma. It was by no means infrequent to have the two in combination and the distinction between direct syphilis and so-called parasyphilis could no longer be upheld.

The two other cases were instances of the condition described by Weir Mitchell under the term causalgia. In the first a gun-shot wound of the internal popliteal nerve on September 26, 1915, had resulted in typical causalgia of the foot—viz., an intensely painful hyperæsthetic condition, chiefly affecting the sole, the pain being aggravated by the slightest tactile impression, or even by a noise, a puff of wind or a jar in the ward. The nerve was cut down on and a spindle-shaped enlargement found which was incised, but the symptoms were unrelieved. He recommended that the nerve should again be explored, and injected with ninety per cent alcohol.

In the second case a gun-shot wound of the left arm above the elbow

on September 25, 1915, had produced a similar train of symptoms in the hand. At an operation performed on November 29, 1915, several small splinters of bone and of metal were found imbedded in the sheath of the radial nerve, and there was a very large number of tiny pieces imbedded in the surrounding tissues. The splinters were removed from the nerve and a certain amount of improvement followed on the operation, but cure is very far from being complete. In this case he recommended similar treatment.

Reviews.

OXFORD WAR PRIMERS: INJURIES TO JOINTS. By Major Robert Jones, R.A.M.C. (T.), Director of Military Orthopædic Hospital, Liverpool. London: Henry Frowde, Hodder and Stoughton. 1915. Pp. 189. Price 3s. 6d. net.

Major Jones is to be congratulated on this excellent little volume. It is one of the most valuable contributions to surgery produced as yet by this War, and is full of sound common sense, which, combined with anatomy, is the basis of all good surgery.

The volume is full of tips, simple and practical, yet so useful both in the prevention of bad results following an injury to a joint and in quickly getting a man well and fit for duty.

The greater part of the book deals with injuries rather than with gunshot wounds, but this is easily understood, as Major Jones sees the after-results of such gunshot wounds and injuries. His remarks, however, on the prevention and after-treatment of ankylosed and stiff joints following gunshot wounds are most lucid and valuable.

We are especially struck by the practical common sense of his views on active and passive movements in the treatment of these injuries, and the importance of not making use of passive movements until they are unassociated with any pain. In fact, this little volume is full of sound common sense.

The mechanism of the production and reduction of dislocations is shortly put, but in a more lucid manner than in the majority of large text-books.

Major Jones is not one who operates in every case of fracture of bone with displacement in or about a joint, and shows very ably how, with patience and knowledge, fractured fragments may be brought together and the need for operation done away with. In fact, if Major Jones's views are carefully studied, the surgeon will not operate on as many cases as before of fracture in or around a joint; and certainly if his lines of treatment are followed in injuries of joints, every surgeon will find his after-results much improved. We can thoroughly recommend this book. Each page is crammed with information, and each word should be carefully read and remembered.

OXFORD WAR PRIMERS: SURGERY OF THE HEAD. By Major L. Bathe-Rawling, R.A.M.C. (T.), Surgeon and Senior Demonstrator of Anatomy, St. Bartholomew's Hospital. London: Henry Frowde, Hodder and Stoughton, 1915. Pp. 150. Price 3s. 6d. net.

Major Rawling has put his views on surgery of the head as relating to gunshot wounds very concisely, and in a short volume has crowded a great deal of sound and useful information. Of course, in a volume of 150 pages it is not possible to give a great deal of information. What there is, is well written and the illustrations (copied from the author's work) are excellent.

This is a most useful little handbook for the surgeon working on the lines of communication rather than at the base, and it is there, at a casualty clearing station, that his views on the necessity of immediate and early operation in cases showing signs of brain compression—viz., headache, slowing of pulse, a rise of blood-pressure—will be appreciated. Also his views on the usefulness of venesection, lumbar puncture, and decompression are sound, and the operation of temporal decompression is shortly but well described.

We cannot agree with the author's opinion, on page 77, that the probe should always be used in preference to the finger in finding osseous fragments driven into the brain. Our own and the general opinion of those working at the Front is that the finger carefully introduced does far less harm than the probe, and certainly detects fragments far better. The finger pushes aside brain tissue where the probe destroys it. The author well emphasizes the importance of making large scalp flaps and large bone and dural openings in all cases of gunshot wounds of the head.

This little book is to be warmly recommended to all interested in military surgery, and especially to those who, working on the field, have to operate at once and early in order to save life. Major Rawling wisely points out that the prolonged search for metal fragments should not be undertaken except with accurate X-ray localization, and such operations should only be performed at the base hospitals, an operation for the relief of urgent symptoms being carried out on the lines of communication.

NOTES FOR EMBARKATION MEDICAL OFFICER, DEVONPORT. Major E. E. Powell, R.A.M.C. Devonport: Hiorns and Miller, 1916. Pp. 96.

This little book would be of invaluable assistance to anyone taking over the duties of Embarkation Medical Officer, Devonport, containing, as it does, full information down to the smallest detail on all matters appertaining to the above post.

It should also be useful to officers doing embarkation medical work at other ports.

Medical officers in command of troops on board transports will find much useful information in Appendix III, a, b, and c.

A point that strikes a reader who is unfamiliar with local conditions is the rather free use of abbreviations, many of which are not quite clear at the first glance—e.g., M.H.D., B.D.M.S., M.E.S.O., R.N.M.T.O.

Explanations of these abbreviations at the beginning of the book seem desirable.

The Primary Lung Focus of Tuberculosis in Children. By Anthony Ghon. Translated by David Barty-King, M.D. London: J. and A. Churchill. 1916. Pp. xxiv + 172. Price 10s. 6d.

The selection of the present time for the publication of this book will, we fear, militate against the due appreciation of its excellence and the importance of the subject with which it deals.

Its title, we venture to think, is unfortunate. It suggests the mere locality of the disease in the lungs as the main consideration, whereas it is even more the "primariness" of its appearance in these organs which, we take it, the author seeks to establish. The work is based on 184 post-mortems of children dying with signs of tuberculosis. The findings, which are tabulated and subdivided with the meticulous care which appears to be the special characteristic of Teutonic scientists (there is, indeed, some difficulty in seeing the wood for the trees), indicate, according to the views of the writer:—

(1) The truth of Parrot's Law—viz., that the enlargement of the lymphatic glands in the neighbourhood of the trachea and its bifurcation implies pre-existing disease of the lungs.

(2) The involvement of the glands in these situations may be out of all proportion to the previous pulmonary trouble, the insignificance of which sometimes necessitates peculiar care in ascertaining its existence.

(3) Tuberculosis of the lungs in children is air-borne, and neither hæmatogenous nor lymphogenous in origin.

(4) The lungs are the commonest seat of the disease in children.

The author expressly disclaims any originality for these views, the essence of which he attributes to Parrot and, after him, to his own countryman Kuess. He is only concerned with emphasizing their truth and importance.

The method adopted is to estimate the period of the original infecting lesion by its pathological characteristics; the most advanced are assumed to constitute the primary focus of the disease. On by far the greater majority of cases (170 out of 184) this was found to be in the lung, and very generally a single spot represented the *fons et origo mali*. Even in most of the remaining cases in which no pulmonary lesion could be found the author is inclined to doubt whether it was not overlooked rather than not existing, so confident is he that the lungs are the "seat of election of the disease."

The spread of the deposit in a fan-like way, with its convexity towards the median plane, in Ghon's view is further proof that the disease in the glands is secondary to its existence in the lungs, holding as he does that if the converse were true, the process being then one of retrograde infection, this arrangement would be reversed.

In the course of the investigation some interesting observations were made as to the indication afforded by the glands of the particular lung area affected, and deductions were also drawn regarding the frequency with which the process invades one or other lung, but these details are subsidiary and rather beside the main argument. If the accuracy of the author's work be assumed, his conclusions must necessarily be accepted. This acceptance involves the relegation of the food origin of tuberculosis to a relatively unimportant place. Nor need this be too alarming a prospect. Too much has been made, to our thinking, of the

intestine as the almost exclusive source of tubercular infection in children, and it is time that a voice of authority should deprecate the sole consideration to that path of entry, for it is at once the strength and weakness of British medical opinion that, if it takes long to form, it is strong to hold even in face of later countervailing evidence. On the other hand, we cannot conceal from ourselves that the author is a strong partizan, and, as the eye tends to see what the heart hopes for, it may be that his enthusiasm has obscured in one or two instances the vision of the scientist. It is possible, but we have not ourselves detected any instance of it in the records furnished. Making due allowance for this source of error, we do hesitate to believe that it can invalidate the main conclusions reached.

An objection of more moment is the small number of post-mortems which furnish the data from which the inferences are drawn. The author, however, is careful to indicate that the series here published is that undertaken to verify the impression formed after long attention to the points raised in the course of his general pathological work. We are ourselves satisfied that, if not absolutely demonstrative of the contentions raised, they furnish more than ample food for serious thought.

The translation is careful, though the clearness of some few sentences might have been increased had the translator diminished the portentous length of the German original; and we plead guilty to preferring our infinitives unsplit!

The publishers' name is sufficient guarantee that the format of the work leaves little to be desired.

CONSTRUCTION, EQUIPMENT AND MANAGEMENT OF A GENERAL HOSPITAL. By Colonel Donald J. MacIntosh, M.V.O., M.B., LL.D., F.R.S.E., A.D.M.S., Lowland Divisional Area. London and Edinburgh: Hodge and Co. 1916. Pp. xii and 164, $9\frac{3}{4} \times 6\frac{1}{8}$. Second Edition. Price 15s. net.

This, the second edition of a book published first in 1909, requires little comment as regards the fulfilment of its purpose. Colonel MacIntosh is a recognized authority on this subject, and criticism fails before that authority. The subject is treated exhaustively, perhaps dogmatically, but every page is useful, without padding.

Many of us are of necessity interested in the construction and management of general and other hospitals at the present moment, but we have to make the best of whichever materials and personnel we can obtain. Even in this relation, however, Colonel MacIntosh's experience gives valuable suggestions on various points, though we cannot contemplate construction on the lines advocated by him.

Chapter XI, dealing with the construction of hospitals of a semi-permanent nature, by John Wilson, F.R.I.B.A., is more in line with our present requirements. The method so common at present is the use of wood frames covered with corrugated iron and lined with asbestos or fibrous plaster. Asbestos in the thickness used is fragile and difficult to repair; the joints must be covered (as suggested by Mr. Wilson) with a half round head, or better a semi-elliptical head, so that the edge next the asbestos may be as thin as possible. Asbestos sheeting does not lend

itself well to the construction of operating rooms and their annexes, as the joints need filling. Fibrous plaster, with the rough side out, covered with a thin layer of plaster and then painted, is much more satisfactory.

The distemper finish of the inside walls, though cheap, is unsatisfactory: it blisters and peels off. Oil paint or enamel as suggested by Mr. Wilson, is much better.

Even though there is an essential difference between the object for which a military or a civil hospital is erected, Colonel MacIntosh's remarks on the various points in control and management are invariably suggestive and adaptable to our hospitals.

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Original Communications.

SOME OBSERVATIONS ON THE EFFECT OF EMETINE ADMINISTRATION ON THE FREE VEGETATIVE FORMS AND CYSTS OF *ENTAMŒBA HISTOLYTICA* AND *ENTAMŒBA COLI.*

BY LIEUTENANT J. GORDON THOMSON.
Royal Army Medical Corps.
AND
CAPTAIN D. THOMSON.
Royal Army Medical Corps.

INTRODUCTION.

THE following observations and experiments were carried out in the Central Laboratory, under the Directorship of Major Ferguson, whom we wish to thank for his valuable advice and assistance. Lieutenant-Colonel Robinson, Officer in Command of a general hospital, allowed us free access to all his cases, and the medical officers on the staff of the hospital gave us every possible assistance. We have to take the opportunity of cordially thanking them all for their great courtesy and co-operation in this work.

SHORT HISTORICAL ACCOUNT OF *Entamœba histolytica* VEL *tetragena* AND *Entamœba coli.*

Schaudinn, in 1903, was the first to point out that two entamœbæ occurred in the human intestine, one of which was pathogenic and which he named *Entamœba histolytica*, and the other non-pathogenic, which he called *E. coli*. Craig, in 1905, fully confirmed

this work. In 1907 Viereck, while studying dysentery, discovered cysts possessing four nuclei, and thinking he had found a new entamœba pathogenic in man, named it *E. tetragena*. Again, in 1909, Elmassian observed very minute entamœbæ, which he named, as a new pathogenic species, *E. minuta*. Walker (1911) and Hartmann (1912) both brought forward evidence that *E. histolytica* and *E. tetragena* were probably different phases in the same species of parasite. James, working in the Panama Canal zone, published a valuable work on the entamœbæ of man (1914). In this excellent paper he describes the pathogenic species *E. histolytica* (Schaudinn), and shows that *E. tetragena* (Viereck) and *E. minuta* (Elmassian) are simply stages in the life-cycle of the same pathogenic species. In the present state of our knowledge, therefore, we recognize definitely two entamœbæ in the human intestine, namely, *E. histolytica* and *E. coli*.

Short Note on Experimental Infection of Animals.

Professor Kartulis was the first to infect cats experimentally by the injection, *per rectum*, of mucus and blood from cases of amœbic dysentery. These experiments were repeated later by Quincke, Roos, Pasquale, Strong, Musgrave, and others. Wenyon introduced free and encysted entamœbæ into the stomach of kittens in doses of five cubic centimetres of the flakes of blood-stained mucus, and he also injected kittens with this material *per rectum*. Similar experimental work has been done by Viereck, Werner, Hartmann, and Darling of the Panama. Wenyon made the valuable observation that the ingestion of free-living entamœbæ by the mouth will not cause amœbic dysentery, but injection of these *per rectum* will do so. On the other hand, he showed that ingestion of the cysts *per os* will cause amœbic dysentery. One of Wenyon's cats developed abscess of the liver.

Authors' Observations on the Formation of Cysts of *Entamœba histolytica* vel *tetragena*.

In a series of 143 cases of definite amœbic dysentery diagnosed by the microscopic finding of *E. histolytica* in the blood and mucus, the typical four-nucleated cysts were found on only eleven occasions, and even then in such small numbers that they were only accidentally found after a long search. *Tetragena* cysts only occur in chronic cases of amœbic dysentery. We have recently found them in enormous numbers in three cases where

the stools were formed and unaccompanied by blood and mucus, but where a past history pointed definitely to an attack of amœbic dysentery. We shall discuss these cases of cyst carriers in a later section of this paper. During the acute attack of the disease we have never found cysts. These develop either in untreated cases or insufficiently treated cases. As soon as the condition of the patient becomes inimical to the free-living vegetative forms of entamœbæ, these immediately take steps to protect themselves, and we have the production of resistant cysts. The *E. histolytica* under favourable circumstances is noted to be much smaller in size and may be only ten microns to fifteen microns in diameter, corresponding with the *E. minuta* of Elmassian. At this stage it often contains rod-like bodies or bars of chromatinic staining material called "chromidia" (fig. 1). The exact significance of these is not known, and we do not intend to discuss them. In the free-living stage of the entamœba the cytoplasm has a definite reticulum, giving the endoplasm the appearance of being finely granular in character. There may be no vacuoles, or only one or two. In the one-nucleated stage of cyst formation the endoplasm seems to lose this reticulate character and becomes more dense and homogeneous, losing its finely granular appearance. At this stage also the cyst is observed to contain one or more vacuoles (figs. 2, 3, and 4). It may, however, be non-vacuolated. Chromidia may or may not be present. Figs. 2 and 3 show the karyosome divided into two. These cysts in fresh preparations are absolutely spherical, but as the cyst wall is very thin they are easily distorted in fixed preparations and assume the various appearances depicted in the plate. The nucleus divides into two, and the cystoplasm still retains its homogeneous, dense character, with one or two vacuoles, as seen in fig. 5. Each nucleus finally divides into two smaller daughter nuclei, and we have the final four-nucleated *tetragena* cyst. At first the endoplasm in these is dense and compact and shows no alveolar structure; the nuclei tend to take up their positions at two opposite poles of the sphere and the vacuoles may persist for a time. We must point out here that the nuclei in stained specimens may not appear to be at opposite poles, as it all depends upon the position in which the spherical cyst was lying during its fixation. For example, they may all appear to be in the centre of the sphere as depicted in fig. 11, but careful focusing will show that these nuclei really lie in pairs at different planes. Nuclei may thus appear to occupy varied positions according to the position of the sphere. As a

matter of fact, our observations place the nuclei in pairs in almost every case at two opposite poles of a sphere. In some of the cysts dark-staining masses are often seen, probably chromidial in nature and varying much in quantity and shape (figs. 8, 9, and 10). The last stage of the mature cyst as seen by us is that the endoplasm loses its dense homogeneous character, the vacuoles disappear, leaving a beautifully reticular arrangement, giving the appearance of fine granules (figs. 11 and 12).

The nuclei of these pathogenic cysts are very characteristic, and differ very remarkably from those found in the cysts of *E. coli*. The nuclei of *E. tetragena* are beautifully clean-cut circles in which the chromatin is often aggregated in a semilunar mass at one side. The minute karyosome occupies a more or less central position in the nucleus. The figures in the plate show this characteristic nucleus very well. We have been quite unable to make out any sexual phase in the formation of these cysts. Dealing with such minute bodies, this is a most difficult task to perform and leaves much to the imagination. It is probable that if a sexual phase does occur it may take place immediately prior to cyst formation by the conjugation of two entamœbæ, or it might possibly take place after the ingestion of the cysts by the conjugation of the small free amœbulæ set free by destruction of the cyst wall.

Size of Cysts of Entamœba histolytica *vel* tetragena.—The diameter of the cyst varies from ten microns to fifteen microns. The diameter of the nucleus varies: in cysts possessing a single nucleus this has an average diameter of three microns; two-nucleated cysts have somewhat smaller nuclei—viz., from 2 microns to 2·5 microns; while in four-nucleated cysts they are still smaller, being only (approximately) 1·5 micron in diameter.

Authors' Observations on the Formation of Cysts of *Entamœba coli*.

It seems almost necessary here to apologize for discussing the cyst formation of *E. coli*, as this has been already so well done by other observers. We thought, however, it might be useful to do so in this paper, so that readers might be able to compare in one paper these cysts with those of *E. tetragena*. The free-living vegetative *E. coli* live in the lumen of the large intestine of man. They do not attack the bowel wall and are therefore non-pathogenic. The endoplasm is quite different in character to that of *E. histolytica*, in that it is more highly vacuolated (fig. 21). The nucleus, in our

experience, is larger in diameter and has much more chromatin under the nuclear membrane. The karyosome is also much larger. In fresh specimens the nucleus is easily seen. We have never found chromidia in the endoplasm of this species, nor have we ever found red cells ingested even when it was present in a stool containing blood and mucus. When cyst formation is about to begin, we find the vegetative forms are very small (fifteen microns to twenty microns in diameter), the nucleus being about 4·5 microns in diameter. At this stage even in stained specimens we have occasionally found them very difficult to distinguish from *E. histolytica*, and they correspond very closely to the *E. minuta* of Elmassian. The vacuolation and the character of the nucleus, as well as the presence of cysts in other parts of the specimen, usually clear up the difficulty. The first phenomenon observed in the cyst formation of *E. coli* is the concentration of the endoplasm, leaving a distinct layer of ectoplasm round the periphery (fig. 22). The ectoplasm then secretes a thick cyst wall, and we have the one-nucleated cyst. The nucleus divides into two, one at each pole of a sphere, with a large clear vacuole between (fig. 23). The endoplasm is squeezed into the margins under the cyst wall by this vacuole. Fig. 24 shows a different aspect of the cyst at this stage, with the two nuclei at one margin embedded in the endoplasm. The chromatin in the nuclei is arranged in masses around the nuclear membrane, and the karyosome is central. In the next stage the two nuclei recede more from the periphery of the cyst wall, and we note that the endoplasm begins to get more reticulate, while the vacuole disappears, as is seen in fig. 25. Each nucleus now divides, and we have four nuclei situated in a finely reticulate endoplasm, more or less in a central position in the sphere. We can afterwards follow the process of nuclear division until six, and finely eight nuclei are present. Fig. 27 depicts a cyst with six nuclei, and fig. 28 shows the final eight-nucleated cyst. The eight-nucleated form has usually a denser central portion, which accordingly stains more deeply than the periphery. The fully developed forms are, from our observations here, usually about twenty microns in diameter and are easily diagnosed under a comparatively low magnification from their size alone. The nuclei of these cysts are also much larger than those of *E. tetragena*. We have been unable to make out any evidence of autogamy or any other sexual phenomena. Cysts with more than eight nuclei occur, and we have found one with sixteen nuclei.

Size of Cysts and Nuclei of Entamœba coli.—Diameter of cysts

as found by us in E., fifteen to twenty-one microns. Size of nucleus of single-nucleated form before division, four to six microns (approximately). Size of nuclei in eight-nucleated stage, 2·5 microns (approximately).

The Effect of a Full Course of Emetine on *Entamœba histolytica*.

The prompt and thorough treatment of amœbic dysentery with emetine is of the utmost importance. The administration of the drug should be commenced immediately blood and mucus are observed in the stool, even though no report as to the presence of entamœbæ has been obtained from the pathologist. Moreover, once emetine has been commenced, it should be continued without intermission until a full course has been given.

In a general hospital, the officers have made it a routine practice to treat the patient with half-grain doses, administered hypodermically twice daily, until at least seven grains have been given. After the completion of such a course we have never been able to detect either entamœbæ or their cysts on microscopical examination, and in such cases the complete absence of cysts in the fæces has been determined by us several weeks after the cessation of the treatment.

We have recently had under observation a patient who had elsewhere received two inefficient courses of emetine at different times. So far as we could learn, he had not had more than a total quantity of four grains of emetine on either of the two occasions referred to. On admission to a general hospital, he was passing blood and mucus in his stools, and microscopical examination of these revealed the presence of very numerous freely moving *E. histolytica*. This was without doubt a true relapse of amœbic dysentery. Under the influence of a thorough course of treatment with emetine he speedily improved.

The effect of emetine on entamœbæ is almost immediate, and we cannot do better than compare it with the action of quinine on the plasmodium of malaria. Just as the administration of quinine should on no account cease with the disappearance of the malarial parasites from the blood, so in the case of amœbic dysentery the failure to find amœbæ or cysts in the fæces should never be held to justify the cessation of emetine. Relapses will occur in amœbic dysentery with the same certainty as in malaria unless a full course of administration of the specific drug appropriate to each be

completed. The failure on the part of a competent and experienced observer to find definite entamœbæ in the blood and mucus of a dysenteric stool depends on several controlling factors, so the clinician, even though the laboratory report be negative, should never allow himself to deviate from the above rule in administering emetine. The striking and rapid improvement so often observed in cases treated fully with emetine, in spite of negative microscopical findings, is abundant justification for its advocacy. The only cases of amœbic dysentery which show no beneficial reaction to emetine, no matter how thoroughly the drug is exhibited, are those in which the colon has suffered such extensive and irreparable destruction of its mucosa that the specific drug is powerless to improve the condition. Unfortunately when amœbic dysentery has assumed the proportions of an epidemic, such cases come to light on post-mortem examination.

From many of the autopsies conducted by Lieutenant Bartlett, R.A.M.C., Pathologist to a general hospital, we have seen that the mucosa may be destroyed almost completely as a result of amœbic dysentery, many of the ulcers involving the entire thickness of the muscular coat, their floors impinging on the peritoneum.

THE EFFECT OF SMALL DOSES OF EMETINE ON *Entamœba histolytica*.

We have recently had four cases of great interest sent here, each giving a former history of blood and mucus in their stools. On admission to this hospital the patients were fairly well and had neither blood nor mucus in their stools. Each had received a single injection of emetine, one-third grain to two-thirds grain. On examination, one of these patients, who was passing solid, well-formed stools, was found to be the carrier of enormous numbers of *tetragena* cysts. Every fæcal deposit must have contained billions of these. We made the first examination of his fæces about four days after the single injection of emetine. The other three cases showed also large numbers of cysts. There can be little doubt that the single dose of emetine given acted beneficially on the patient by killing large numbers of the entamœbæ and also stopping their active multiplication, but, on the other hand, it had the effect of bringing about the phenomenon of encystment, and the patient was converted in the meanwhile into a highly dangerous carrier. This is a point of the greatest importance in the treatment of dysentery. The course must be efficient and complete before a patient is allowed to leave hospital. It would also appear that a continuous course is

better than an intermittent one, as in cases so treated we have never found cyst formation.

The Effect of Emetine on the Destruction of Cysts of *Entamœba tetragena.*

Four cyst carriers were treated with emetine, two half-grain doses daily by hypodermic injection, until six grains in all had been administered. At the same time magnesium sulphate (two drachms every four hours) was given daily so as to get a thorough action of the bowels. The cases were all treated in this manner by Lieutenant Diamond, to whom I wish to express my thanks for allowing me to investigate thoroughly the effect of his treatment. In all four cases we were quite unable to find cysts after the completion of this treatment. The most interesting case had an enormous infection of cysts. Before commencing treatment we observed specimens of fæces for three successive days, the stool being obtained by purgation as the patient was constipated at the time. The cysts remained as numerous as on the first examination. Specimens of these fixed in Zenker's fluid, and stained by Heidenhain's iron hæmatoxylin method, showed that the four-nucleated cysts predominated (figs. 11 and 12). No marked changes were seen in these cysts after the administration of two grains of emetine, and they seemed to be quite as numerous. The relative proportion of one-nucleated cysts and two-nucleated cysts increased. After three grains of emetine the cysts were less numerous; they were all one-nucleated and each contained a single large vacuole such as can be seen in developing cysts. It is a very difficult matter to determine whether these vacuolated cysts are really degeneration forms or not. In our view there is no clear evidence of their being degenerate in nature; it appears probable from observations which we have made on the development of cysts both of *E. coli* and *E. histolytica*, as illustrated in the plate, that the forms under discussion may be the normal precursors of the mature cysts. We must, however, leave the matter here as still open to further investigation. After four grains of emetine the examination of a fresh specimen of the fæces still showed numerous spherical cysts. When fixed and stained, these were found to be all one-nucleated. No definite cyst wall could be seen, and if present at all it must have been extremely thin. They looked, both in the fresh and stained specimens, more like tiny entamœbæ. We did not observe any motility in them. They are represented in figs. 17 to 20. No vacuolation is seen in figs. 17 and 18, but slight vacuolation is shown

in fig. 19, and several clearer ones are seen in the endoplasm in fig. 20. The nucleus of each was beautifully preserved. Captain O'Connor, R.A.M.C., who examined these slides at our request, is also of the opinion that they are tiny free entamœbæ. After five grains of emetine no further cysts could be found. The treatment was continued for another day, and the patient therefore received a continuous treatment of six grains of emetine. We examined his fæces daily for one week afterwards, and no return of cysts was noted. Patient was then discharged, presumably a non-carrier. We are of the opinion that the emetine does not destroy cysts when once these are formed, but the drug acts on the entamœbæ which are the cyst producers and kills them. It would seem that one or two grains of emetine are insufficient to do this, as we have found at this stage of emetine treatment one-nucleated and two-nucleated cysts in process of development. The fact that after four grains of emetine we only found one-nucleated small free entamœbæ would seem to point out that these were making a last effort, as it were, to encyst themselves and had been then swept out of the gut wall. Five grains of emetine evidently completed the destruction, as after the fifth day neither entamœbæ nor cysts could be found. We think that it is very important to give magnesium sulphate regularly during the period covered in treatment with emetine, in order to expel thoroughly the cysts from the bowel. The effect on cysts of *E. tetragena* throws an extremely interesting light on the probable minimum dose capable of killing off entamœbæ. This dose is probably five grains. We have known cases to relapse after four grains, this dose being evidently insufficient to kill all the cyst producers.

The Effect of Full Doses of Emetine on *Entamœba coli* (Free Vegetative Forms) and on their Cysts.

E. coli or its cysts has probably been the commonest protozoon found in the fæces of diarrhœal or dysenteric cases amongst the troops. It seems quite harmless, and when present seems to be unaccompanied by any serious results. It is almost impossible to conduct experiments with this entamœba, as after many observations we find that it will disappear from the intestine under the influence of simple purgation, or apart from any known cause. Emetine, moreover, would seem to have no effect on preventing the appearence of this species in the human intestine, as after a full course of emetine we have found *coli* cysts still persist, and even free vegetative forms.

Some Observations on the Persistence of Cysts in Fæces kept in the Laboratory.

We have found cysts of *E. tetragena* in a mass of solid, moist fæces kept in a test-tube after the lapse of sixteen days. These showed no signs of degeneration. Cysts of *E. coli* were also found in good preservation after a week in a solid stool kept under similar conditions. On the other hand, cysts seem to disappear within one or two days from very fluid stools.

We have also made observations on the persistence of cysts in fæces mixed with sand. We find that, provided precautions are taken against complete desiccation, cysts can be readily found after a lapse of at least fourteen days.

Methods of Infection.

Infection with amœbic dysentery undoubtedly takes place by means of cysts, which in some way are conveyed to the mouth and swallowed. The experiments of Wenyon and others on kittens completely demonstrated this. We have ourselves recently infected a young kitten by contaminating its food (fish and milk) with cysts from a "carrier." The animal was not forced to take the food, but spontaneously did so with relish. Cysts of the pathogenic amœba are conveyed to man by the accidental contamination of his food, or by his hands, or by the agency of flies. Contamination of food may occur—(*a*) when particles of fæces containing cysts are blown by the wind on to the surface of food; (*b*) by means of flies soiled with material containing cysts; or (*c*) by the contaminated fingers of a cook or servant. Fæces deposited on the desert, particularly in the neighbourhood of a camp, soon becomes pounded up and thoroughly mixed with the sand, by the feet of many passing over them. We have found that the sand particles adhere to small fragments of the still moist fæces, surrounding them completely like a shell. Strong gusts of wind may carry such infected particles long distances, possibly even direct into the mouth or on to the lips of any one in the neighbourhood.

It is practically certain also that flies which have become externally soiled with material containing cysts may deposit these either by alighting on food or directly on the lips, whence they may easily find their way into the mouth. We are conducting further experiments on this subject, which we consider quite as important in relation to dysentery as in the case of any other disease known to be transmitted by flies.

Summary of Conclusions.

(1) If an amœbic case receive a continuous course of treatment with emetine of not less than a total of seven to ten grains of the drug administered in grain doses daily for a week, it is probable that he will never become a carrier of cysts. In order, however, to make certain of this, it is better to carry the treatment further. Such treatment also prevents relapses.

(2) Cysts of *E. histolytica* can be cleared out of a patient after six grains of emetine, but, to make absolutely certain of this, it is better to exceed this dose. This treatment must be combined with saline purgatives, so as to get free daily action of the bowels.

(3) A case of amœbic dysentery inefficiently treated with less than seven grains of emetine is likely to become highly dangerous as a carrier of cysts. One or two small doses may act beneficially and get rid of active symptoms, such as the passage of blood and mucus, but it may at the same time stimulate the formation of large numbers of cysts. The cessation of treatment on the disappearance of active symptoms is fraught with danger, both to the patient and, subsequently, to others.

(4) All patients known to have blood and mucus in their stools and to have received less than an efficient total quantity of emetine ought to be examined for the presence of cysts in the fæces, as it is highly probable they have thereby become dangerous carriers.

(5) The transmission of amœbic dysentery is undoubtedly due to the ingestion of cysts. This is brought about by the contamination of food, fingers, or flies. Cysts may also be carried along with sand particles by wind.

(6) The powers of resistance of cysts outside the body are considerable, and this should be borne in mind by all responsible for sanitary prophylactic measures against dysentery.

DESCRIPTION OF PLATE.

All these figures were drawn from preparations which were fixed wet in Zenker's solution and stained with Heidenhain's iron hæmatoxylin method. The magnification is approximately 1,050. All the cysts in fresh specimens are absolutely spherical. Oval shapes and distorted forms are produced by the smearing of the fæces on a cover-slip prior to fixation.

FIG. 1.—A small *E. histolytica* showing "chromidial bodies." The endoplasm is finely reticular in character and the nucleus is eccentric. No vacuoles are seen in this specimen, but often one or two occur, and there may be many, especially when red cells are being phagocytosed. The nucleus, just prior to encystment, is usually rather richer in chromatin than during more acute stages of the disease.

FIG. 2.—A *tetragena* cyst with a single nucleus. The karyosome is divided into two. In this specimen the endoplasm is not reticulate in appearance, but is stained homogeneously. A clear, vacuolated portion is seen.

FIG. 3.—A *tetragena* cyst with a single nucleus showing a crescentic arrangement of the chromatin at one margin of the nuclear membrane. The karyosome is divided into two. The cyst contains a large vacuole, but a vacuole is not always present. The endoplasm is dense and non-reticulate in character.

FIG. 4.—A small *tetragena* cyst, oval in shape due to distortion. The nucleus is single and the karyosome is not divided into two. Vacuolation is to be noted in the endoplasm.

FIG. 5.—*Tetragena* cyst with two nuclei. The endoplasm has in this specimen a compact appearance, but at this stage it may be reticular in character. Vacuolation of the endoplasm is seen. The chromatin of the nuclei has the crescentic form at the margins of the nuclear membrane.

FIG. 6.—A *tetragena* cyst with four nuclei. The endoplasm in this specimen is compact and not reticulated. Several vacuoles are present. At this stage the endoplasm is usually finely reticular in character and there is no vacuolation. The nuclei are very small and the dense crescentic little masses of chromatin at the nuclear margins are very characteristic.

FIG. 7.—*Tetragena* cyst with four nuclei and a bulge at the lower margin produced by distortion. The nuclei are arranged in pairs at opposite poles. The endoplasm is compact and non-reticulate. A few vacuoles are evident.

FIG. 8.—A *tetragena* cyst with four nuclei and a large chromidial mass embedded in the endoplasm. The cytoplasm in this specimen has a finely reticulate appearance. The nuclei appear at one side owing to the position of the spheres during fixation. Each nucleus has the sharply defined crescentic mass at one margin of the membrane. There is no distortion of the cyst wall and we have the normal circular appearance of these cysts as seen in fresh specimens.

FIGS. 9 and 10.—These show *tetragena* cysts with reticular endoplasm and "chromidial bodies" embedded in it. Fig. 9 has only three visible nuclei, and probably one is hidden by the chromidial masses.

FIG. 11.—A *tetragena* cyst with a finely reticular endoplasm. The nuclei appear to be centrally placed, but these are really on different focal planes and are in pairs at the upper and lower poles of the sphere.

FIG. 12.—A *tetragena* cyst showing the nuclei arranged in pairs at opposite poles. The endoplasm is reticulated, which gives the appearance of being finely granular. There are no "chromidial bodies" to be seen.

FIGS. 13 to 16.—These show *tetragena* cysts found in the fæces after the administration of three grains of emetine. All the cysts were one-nucleated and each had a vacuole.

FIGS. 17 to 20.—Minute entamœbæ found in the same case as the above, after the administration of four grains of emetine. They were not seen to be motile, but they did not seem to be degenerated.

FIG. 21.—A small *E. coli* (free form), showing vacuolated appearance of the endoplasm. The nucleus is large and the chromatin occurs at the inner margin of the nuclear membrane. The karyosome is large and rich in chromatin.

FIG. 22.—This shows early formation of a cyst of *E. coli*. The endoplasm seems to become differentiated from the ectoplasm.

FIG. 23.—A two-nucleated *coli* cyst, with a large vacuole. The two nuclei are at opposite poles in the endoplasm, which has been concentrated at the margin.

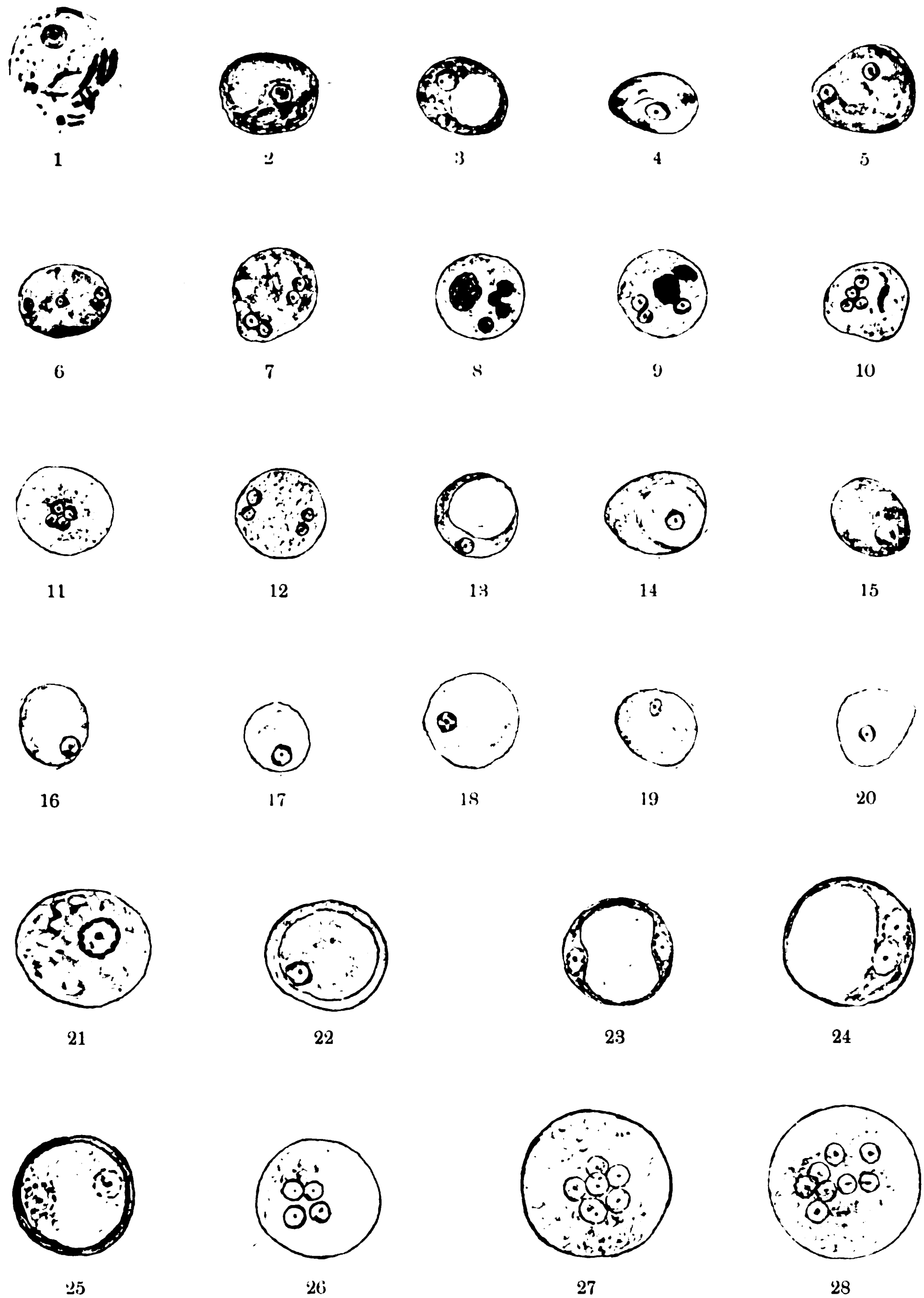
FIG. 24.—A two-nucleated *coli* cyst showing the nuclei at the same margin of the sphere.

FIG. 25.—A two-nucleated *coli* cyst, showing less vacuolation and the beginning of a reticulate endoplasm.

FIG. 26.—A four-nucleated *coli* cyst, with finely reticulate endoplasm. The nuclei are more or less central.

FIG. 27.—A six-nucleated *coli* cyst with nuclei arranged in the centre. Cytoplasm is reticulate.

FIG. 28.—*E. coli* cyst with eight nuclei. This cyst shows a darker-staining central area and the reticulate endoplasm at the periphery.



J. G. Thomson, del.

PLATE

To illustrate "Some Observations on the Effect of Emetine Administration on the Free Vegetative Forms and Cysts of *Entamœba Histolytica* and *Entamœba Coli*," by Lieut. J. Gordon Thomson, R.A.M.C. (T.C.), and Captain D. Thomson, R.A.M.C. (T.C.)

REPORTS OF THE M. AND H. LABORATORIES DEALING WITH THE DISEASES AFFECTING THE TROOPS IN THE DARDANELLES.

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At the instigation of Surgeon-General Babtie, V.C., a field laboratory was established at M. E. in the end of July with the object of providing bacteriological assistance for the stationary and other hospitals located there.

A month later sufficient equipment had arrived to furnish an extension laboratory at W. B., C. H. This extension laboratory was placed in the charge of Lieutenant W. Campbell, R.A.M.C., and was primarily intended to be of service in the event of a cholera outbreak or serious epidemic among the troops on the Peninsula.

Efforts were also made to establish a similar type of laboratory at A., but the scheme was abandoned owing to the difficulty of obtaining a water supply and to the constant and concentrated shell fire existing there.

As a central laboratory for the Peninsula the site at M. was a favourable one, inasmuch as it was only a few hours distant from the Peninsula, and opportunities were thus available for the early clinical study and bacteriological investigation of the various diseases prevalent among the fighting troops and on the lines of communication.

This report deals with the work carried out at M. E. laboratory for a period of five and a half months, dating from August 1, 1915, to January 15, 1916, and also with the investigations of the H. laboratory from September 4 to the time of the evacuation.

Before alluding to the different diseases occurring on the Peninsula and at M. it would be well to refer briefly to the climatic and other prevailing conditions that directly and remotely influenced the disease incidence.

During the months of June, July, August and September there

was a low rainfall accompanied by a comparatively high temperature and an affluence of flies and dust—in short, an ideal state of things well fitted for the spread of fly- or dust-borne diseases.

In October and the following months the fall in the temperature and the increased rainfall had a determining influence in the diarrhœa and amœbic dysentery incidence. The former practically disappeared, while the latter was almost entirely replaced by the bacillary type of the disease. It was also observed that, coincident with the change in the climatic conditions, there was an increase in the paratyphoid A incidence; indeed, during the months of December and January it had almost entirely taken the place of the paratyphoid B infection.

Source of Material.

Most of the material sent for examination was supplied by the stationary hospitals and the Indian Field Ambulance; some, however, was also obtained from naval and mercantile ships anchored in the harbour. The majority of the cases were illustrative of infections acquired either on the Peninsula or in M. Reference will now be made to the more important diseases investigated clinically and in the laboratory.

The Dysenteries.

During the months of July, August, September and October, the dysentery most prevalent on the Peninsula was undoubtedly amœbic in type. Almost all the cases represented infections with *Entamœba histolytica.*

The stools in the majority of instances were typically dysenteric, consisting of blood and mucus with or without fæcal material.

A large number of these specimens when examined microscopically contained relatively few organisms, but, as a matter of routine, whether entamœbæ were present or absent, a sample of the stools was plated, either on McConkey's bile salt neutral red lactose agar or on Endo's or Drigalski-Conradi's media. By adopting this procedure the risk of missing bacillary or other concomitant infections was minimized.

For the purpose of demonstrating the cytological characters of the causal amœba, specimens were suitably stained either by iron hæmatoxylin or Hasting's method.

Pressure of work, however, did not always permit of laborious staining methods being employed, and in such instances the

diagnosis was based on the evidence obtained by direct examination of the entamœba and its cysts. Entamœbæ containing phagocyted erythrocytes were considered pathogenic and not of the *E. coli* type, a view also held by Wenyon and other protozoologists. In a few instances *E. coli* was found.

Clinically, the cases resembled those of entamœbic dysentery, and in the majority the exhibition of emetine was a therapeutic success provided that a total amount of ten grains had been administered over a short period. Some cases, however, proved fatal, post-mortem evidence showing either the existence of perforations of one of the multiple amœbic ulcers in the colon or the presence of liver abscesses.

Bacillary Dysentery.—This type of dysentery was comparatively uncommon in the months of August, September and October. In November, however, the case-incidence increased somewhat, and in the following month it was practically the sole type of dysentery found. Clinically, although never in epidemic form, some of the cases were very severe, but responded in a striking manner to the use of a polyvalent dysentery serum (*vide* chart, fig. 4).

The Shiga group of organisms was more common than the Flexner. In eleven instances bacilli giving the cultural characters of the dysentery group were isolated, but remained unidentified owing to their failure in responding to specific agglutination tests.

The bacillus of Shiga was obtained on thirty-five occasions, that of Flexner on twenty-three. The total number of dysentery organisms isolated, including the unidentified strains, was sixty-nine.

During the five and a half months 1,921 stools were examined; of these 518, or 27 per cent, represented dysenteric stools; of the latter 70 per cent were due to amœbic infections and 13 per cent represented bacillary dysentery infections. In the remaining seventeen per cent no apparent causal organisms were found.

THE DIARRHŒAS.

During August, September and October diarrhœa was very prevalent among the troops both on the Peninsula and at M. With the onset of the rains and the cold weather, however, the incidence of this complaint abated in a striking manner. A large number of diarrhœic stools were examined microscopically and bacteriologically, and the following conclusions arrived at regarding their etiology.

Sand Diarrhœa.—When sand-storms were common, the

diarrhœa incidence was high, and sand as a causal factor was considered a probable one, either by its direct irritating effects on the mucosa of the intestinal tract or, as was more likely, by the mechanical transmission of micro-organisms attached to sand particles. It would be difficult, however, to attribute entirely the cause of these diarrhœas to the effects of sand when another agent and menace—the fly—existed as a serious pest. No stretch of the imagination was required to understand how food could be fæcally fouled by the common fly; probably the two factors, flies and dust, were responsible for the greater number of the diarrhœas.

In a large proportion of these diarrhœas the predominant organism was a non-lactose-fermenting diplostreptococcus which grew readily on McConkey's medium in the form of delicate, clear colonies. The preponderance of this organism, as seen in stained preparations of the stools, left little doubt that it was responsible in causing diarrhœa. In 1·5 per cent of cases Morgan's bacillus was the only known pathogenic organism isolated.

Several cases of diarrhœa, especially during the month of October, were apparently due to infections with vibrios and spirilla. Most of these vibrios were coarse in type, but in a few instances they morphologically resembled the cholera vibrio, so much so that it was deemed necessary to subject them to crucial cultural and agglutination tests.

Some of the vibrio infections were responsible for a severe and choleraic type of diarrhœa, associated with "cramps." In no case, however, was a true cholera vibrio isolated.

Trichomonas Diarrhœas.—Trichomonas intestinalis was observed on fifty-seven occasions, and usually in fluid stools containing bile-stained mucus. These flagellates are apparently capable of causing diarrhœa, particularly when present in large numbers. Little is known regarding their pathogenicity. In guinea-pigs, however, they have been known to set up a severe and fatal enteritis.

Flagellates of the genera *Cercomonas* and *Tetramitus* were observed in only a very few cases and require no further comment.

Malaria.

Subtertian parasites were found in two cases, and parasites of the benign tertian type were found in twenty-four. All of the latter had acquired their infection on the Peninsula and chiefly in the vicinity of H., where anopheline mosquitoes had been found breeding by Lieutenant-Colonel Balfour, C.M.G., of the Sanitary Commission.

Relapsing Fevers.

Forty-six cases were diagnosed by blood examination. These occurred among the I. troops and men of the E. Labour Corps. In only one instance were spirochætes found in the blood of a British officer, who previously had been in command of the E. Labour Corps.

Some comparative observations were made with the I. and the E. relapsing fever cases, and the evidence collected was in favour of the duality of the species of spirochæte. Unfortunately it was not possible to carry out crucial tests by cross-immunization.

A large number of spirochætes were measured, and the average length of the I. species was 12·56 microns, while the E. measured 16·8 microns. In the former, coils, figures of eight and skein forms were relatively more numerous than in the latter.

Clinically, the E. relapsing fever was more severe, showed more irregularities in temperature and in the intervals of apyrexia, Jaundice and liver and splenic enlargement were invariably present. and pulmonary symptoms conspicuous by their absence.

In the I. type the symptoms were less severe, and jaundice and splenic enlargement not common. The average period of apyrexia was seven days. Pulmonary symptoms were usually present. In a few cases epistaxis was noted.

Owing to the early transfer of the cases, no comparative observations could be made to show the number of relapses in the two types of the disease.

As regards the method of transmission, circumstantial evidence has certainly implicated the body-louse, *Pediculus corporis.*

Infective Jaundice.

Evidence is still lacking to prove whether or not an organism is concerned in the etiology of this condition. Blood cultures have been carried out in different stages of the disease, but the results obtained have been disappointing and indicate that the existence of a bacillæmia is the exception and not the rule.

In one instance *Bacillus paratyphosus* B was obtained by blood culture, and in another—a fatal case—a similar organism was isolated from the gall-bladder; this viscus showed all the signs of a cholecystitis.

From material representing the syphoned duodenal contents of a case of jaundice under the care of Major Hertz, a Gram-negative diplococcus, probably of intestinal origin, was obtained.

Typhoid and Paratyphoid Fevers.

Bacilli of the typhoid-paratyphoid group were obtained by blood culture from 147 cases; of these 21 were *B. typhosus*, 41 *B. paratyphosus* B, 70 *B. paratyphosus* A; in addition, there were 15 inagglutinable strains of the paratyphoid group, of which 1 resembled *B. paratyphosus* A in type, others *B. paratyphosus* B.

From the stools during the same time 18 strains of *B. typhosus* were obtained, 50 of *B. paratyphosus* B, 11 of *B. paratyphosus* A, while 72 strains were obtained which culturally resembled the paratyphoid group but were not agglutinable by the specific sera. Some of these were probably true paratyphoid, others were probably not.

One *B. paratyphosus* B was obtained post mortem from the gall-bladder of a case which had marked jaundice as a symptom; one *B. typhosus* post mortem from a mesenteric gland, while *B. typhosus* was isolated from the pus of a suppurative osteo-arthritis following frostbite.

Methods.

Blood culture in the first week of the disease being regarded as the ideal method of diagnosis of the enterica, this procedure was adopted whenever possible. The less satisfactory methods of agglutination tests with the patient's serum and examination of the stools were resorted to where request for blood culture in the early stages has not been made or where blood culture had proved negative; in some instances, too, the patients had passed the stage of bacillæmia by the time they reached hospital.

Many opportunities of doing blood culture were lost owing to prevailing sand-storms that rendered an aseptic operation in the tents impossible.

A two per cent solution of sodium taurocholate in distilled water was the medium used for blood culture. As a rule, from five to seven cubic centimetres of blood were put into ten cubic centimetres of this medium at the bedside. It is important that the blood and culture fluid should be well mixed by shaking before being placed in the incubator. From this preliminary medium McConkey's plates were spread daily for four successive days till a growth was evident, when subcultures were made from isolated colonies, tested in lactose, glucose, mannite, dulcite, saccharose, and peptone water, and put up against the agglutinating serum or sera indicated by the cultural reactions.

For fæces McConkey's plates were used as a routine, with Endo

and Conradi-Drigalski as an occasional variation. Likely colonies were subcultured, put through the sugars and tested by agglutinating sera, as in the case of the blood cultures. Every stool was examined microscopically for the presence of amœbæ, flagellates, etc.

Clinical Features.

The onset of illness was in many cases sudden ; in others the patient was out of sorts for two or three days before being compelled to go off duty.

In the first stages feverishness, headache, shivering and generalized pains were common to practically all ; giddiness was frequently complained of. A furred tongue was almost invariably seen, usually furred and dry, occasionally furred and moist. Abdominal tumidity and tenderness on palpation were common ; many cases gave on palpation what may be described as a "doughy" feeling. There was as a rule no palpable enlargement of the spleen until bacilli had disappeared from the blood ; exceptionally it was enlarged in the first week, and in one case of *B. paratyphosus* A infection it was definitely enlarged on the third day of illness. Spots were not as a rule present in the first week, but appeared irregularly in the majority of cases during the course of illness.

In the series of cases from which paratyphoid bacilli were obtained from the blood, forty-eight per cent of the *B. paratyphosus* A cases and thirty-five per cent of the *B. paratyphosus* B showed diarrhœa as a marked symptom. In the same series vomiting was present in the initial stage of thirty-one per cent of the *B. paratyphosus* A cases and in nineteen per cent of the *B. paratyphosus* B.

Constipation was present at some time of the illness in many of the cases, and epistaxis was present in a small proportion.

The duration of temperature varied in these positive cases from a week to a month, being on the average longer in *B. paratyphosus* A infections than in the other.

There was no doubt that in this series the *B. paratyphosus* A infections were the more severe of the two.

Duration of the Bacillæmia.

An average of the duration of illness at the time of blood culture gives the following results (positive cases only) :—

All cases, including typhoids and infections by inagglutinable paratyphoid-like bacilli	6·35 days.
B. paratyphosus B infections	5·37 ,,
B. paratyphosus A ,, ...	5·99 ,,
B. typhosus infections	8·30 ,,
B. paratyphosus (inagglutinable infections)	9·1 ,,

In only six cases of paratyphoid was blood culture positive on the tenth day of illness or later. *B. paratyphosus* B was obtained on one occasion on the tenth day. *B. paratyphosus* A was obtained three times on the tenth day of illness, once on the eleventh, and once on the fourteenth. These figures are exclusive of cases of true relapse where there is a fresh flooding of the blood by bacilli.

There appeared, therefore, to be a longer bacillæmia in the *B. paratyphosus* A infections than in the *B. paratyphosus* B, with the *B. typhosus* infections longer than either. The nine days' average duration in cases where an inagglutinable paratyphoid bacillus was obtained is striking, and it is a matter for speculation whether there is any connexion between the inagglutinability of the organism and its length of duration in the blood.

These facts go to emphasize the necessity of making blood cultures in the *first* week from all patients showing a sudden or moderately sudden illness with rise of temperature, headache, shivering, generalized pains, and a furred tongue. The disadvantage of doing a blood culture on a patient who ultimately proves not to be paratyphoid is small compared with the danger of having a paratyphoid patient labelled P.U.O. or influenza, and acting as a focus of infection for all around. It is frequently a fortnight from the commencement of illness before agglutinins have formed in sufficient quantities to give a positive agglutination reaction with strains of paratyphoid bacilli, while the uncertainty of isolating the bacillus from the stools is well known.

Characters of the Bacilli.

The cultural differences between our strains of *B. paratyphosus* A and *B. paratyphosus* B are very striking in organisms which produce clinical conditions so similar. Morphologically the A type is more consistent in its characters than the B; it is a small, short, rather squat coccobacillus of active mobility, and in hanging-drop preparations shows a typical globular appearance, due to the small bacilli searching the upper reaches of the fluid and impinging on the under surface of the cover-glass. The B type shows greater pleomorphism, but as a rule is more bacillary in form than the A.

Its mobility also varies more, and it is not uncommon to find strains of *B. paratyphosus* B which show practically no mobility in saline emulsions of *twenty-four hours'* agar-slope cultures.

A noticeable characteristic of *B. paratyphosus* A is its behaviour while agglutinating under the influence of the specific serum. After the organisms have lost their power of progressive movement they retain a twirling rotatory movement. One frequently sees a whole clump of agglutinated bacilli, eight to twelve in number, spinning round.

In sugars in peptone water the two varieties exhibited a marked difference. *B. paratyphosus* B showed, as a rule, strong acid and gas production *at the end of twenty-four hours* in glucose and mannite, in dulcite a commencing acid reaction and a small bubble of gas, while in lactose and saccharose there was no change. At the end of forty-eight hours the change in dulcite was slightly more marked. There were strains of *B. paratyphosus* B, however, both from blood culture and from stools, which produced no change in dulcite even after four days' incubation, and also two strains, one from the blood and one from the stools, which fermented glucose, mannite, and saccharose but not dulcite; these were definitely agglutinated by the serum. Our sample of dulcite, unfortunately, was not so far above suspicion as to lead one to lay much stress on this delayed or absent dulcite fermentation.

The strains of *B. paratyphosus* A showed very typical and consistent reactions in the sugars. *At the end of twenty-four hours* there was an acid reaction with a small bubble of gas in glucose, an acid reaction only in mannite, while the other sugars showed no change. *In forty-eight hours* there was gas formation in mannite also, while in from three to five days the dulcite showed slight fermentation with a small bubble of gas. The amount of gas production by *B. paratyphosus* A was very small compared with that of *B. paratyphosus* B.

On McConkey's plates the paratyphoid A colonies were very small and delicate at the end of twenty-four hours' growth; in forty-eight hours they were slightly larger, but never so large that one could mistake them for the larger colonies of *B. paratyphosus* B. The latter varied considerably in size even on a twenty-four hours' plate; but on a portion of the medium where colonies were few were about twice the size of a *paratyphosus* A colony of the same age and under the same conditions. On agar slopes the organisms showed no resemblance one to the other. The A exhibited a delicate growth difficult to distinguish from a *B. typhosus*; the B a relatively heavy, often slightly viscid, growth.

The serum used for agglutination tests was, for the *B. paratyphosus* B, a Lister Institute stock. The strains of *B. paratyphosus* A did not always agglutinate satisfactorily with the Lister A serum, possibly because of a non-specificity for the strain of *B. paratyphosus* A prevalent in these parts, but agglutinated well with the Pasteur Institute A serum. It is probable that the non-agglutinable strains of A type obtained from the blood during early autumn would have proved agglutinable had the Pasteur Institute serum been then available.

The inagglutinable strains of paratyphoid-like bacilli isolated from the stools require mention. During August, 1 strain was isolated, during September 5, during October 19, during November 37, and during December 5. These were definitely not *B. paratyphosus* A, but approximated in cultural characters to the B type. Thirteen of these fermented glucose, mannite, and saccharose, and would have been definitely put outside the paratyphoid group had it not been for the two similar strains already referred to, which were agglutinated by paratyphoid B serum. It is probable that the majority at least were not true paratyphoid organisms.

Of the remaining fifty-four strains, five showed rapid dulcite fermentation, in addition to the fermentation of glucose and mannite. Ten strains were left in the incubator for one week, and at the end of that time showed no change in dulcite. Many of these inagglutinable strains gave a heavier growth on agar, and rather larger colonies on McConkey's medium than did any of the agglutinable strains of *B. paratyphosus* B. The majority were obtained from the stools of patients clinically diagnosed as paratyphoid, but a certain number were obtained from cases which were suffering from diarrhœa or dysentery, and which had had no symptoms of paratyphoid. In this connexion it is interesting to note that in one case a *B. paratyphosus* B, and in two cases inagglutinable paratyphoid-like bacilli, were isolated from patients then suffering from diarrhœa without temperature, who a few days later developed paratyphoid fever.

In two cases the serum of the patient was tested against the inagglutinable strain isolated from his stool, but with negative results. Only one strain was agglutinated by Gaertner serum. A small number were also tested against Aertrycke serum with negative results.

There was therefore some difficulty as to how to regard these organisms. With a limited equipment and lack of animals for experiment, it was not possible to come to a conclusion as regards

their pathogenicity, and it was therefore judged well to err on the safe side and regard them as possible sources of infection. The large number of organisms of this type prevalent in the stools in November when the *B. paratyphosus* B epidemic was on the wane—as shown by blood cultures—is a matter of interest, but one can only speculate as to the significance. A number of strains have been kept, and it is hoped that an opportunity may be found later of working them out more fully.

Preventive Inoculation.

Reliable histories as to previous inoculation were obtained from fourteen of the cases from whom *B. typhosus* was isolated. Of these five, or 35·7 per cent, had been previously inoculated against typhoid, while nine, or 64·28 per cent, had not been inoculated.

It was noteworthy that one at least of the inoculated cases ran such a mild course that there was little resemblance clinically to true typhoid.

Out of 126 cases of paratyphoid from which the bacillus was obtained by blood culture, 109, or 86·5 per cent, had been inoculated against typhoid, while 17, or 5·8 per cent, had not been inoculated; none had been inoculated against paratyphoid.

These figures and those previously given, showing the very low relative incidence of true typhoid, demonstrate the efficacy of antityphoid inoculation against typhoid fever, but they also show that antityphoid inoculation produces no protection against paratyphoid.

Antiparatyphoid inoculation, to be effective, must be against both A and B, and, while it is important that the vaccine should contain a mixture of strains of each, it is still more important that *local* strains from the locality to which the inoculated man is about to proceed should be included.

The Course of the Epidemic.

The accompanying chart (fig. 1) shows the relative proportions of the three main types of enterica prevalent at M. during the months August to January. No inagglutinable strains and no cases diagnosed by agglutination tests with the patients' serum are included. The figures represent the number of *B. typhosus*, *B. paratyphosus* B, and *B. paratyphosus* A obtained from patients during each month in the Laboratory, calculated as a percentage of the total number isolated each month of the three combined.

The striking feature is the change in the type of the enterica

prevalent during these months. In August typhoid led the field. The majority of these cases were almost all uninoculated, but unfortunately accurate records of inoculation in these early cases were not kept; the percentage of typhoid in inoculated men already given is therefore higher than it actually should be.

In September and October the paratyphoid B steadily rose, while the typhoid and paratyphoid A fell to a negligible amount. During this time and during the first half of November paratyphoid B was the type which filled the enteric division in the 15th Stationary Hospital.

About the middle of November, with almost startling suddenness, the paratyphoid A shot up, while the paratyphoid B fell. The typhoid, as before, remained low.

Many of these cases had acquired the disease locally at M., others on the Peninsula. The figures obtained indicated that, so far as the Peninsula was concerned, paratyphoid A was more common at S. and A. than at H.

It was not possible to come to a definite conclusion as to the origin of these epidemics.

Other Organisms in the Blood.

In several cases, clinically resembling paratyphoid, a diplostreptococcus was obtained in blood culture. This coccus grew well in taurocholate solution and on McConkey's medium. It was usually obtained in pure culture and as a rule during relapse. The delicate nature of the organism and the conditions under which it was obtained supported the view that it came from the blood and was not a contamination.

This organism was apparently the same as that already described in cases of diarrhœa, and corresponded in many ways to the enterococcus of Thiercelin. It grew, however, more easily on bile salt media than the enterococcus is wont to do. The conclusion was come to that this organism was probably of intestinal origin, and that it might be a cause of secondary rises of temperature in cases of true paratyphoid.

Concomitant Infections.

It was common, particularly during the earlier months, for a patient to be suffering from a second infection in addition to his paratyphoid. Several patients came in with paratyphoid and developed amœbic dysentery during their illness (*vide* chart, fig. 7).

Still more came in with dysentery and contracted paratyphoid. It is not possible to give exact figures of the number of these cases in this report.

The following figures show mixed infections found at a single examination of a patient's stool. The table could be greatly enlarged if the results of more than one bacteriological examination of one patient were included:—

	Entamœbæ	Trichomonas	Vibrios
Typhoid	4	0	0
Para B	3	5	2
Para A	0	0	0

Below is appended a table giving the total figures of typhoid and paratyphoid cases bacteriologically diagnosed, agglutination tests being included:—

	Blood culture	Stools, urine, etc.	Agglutination tests	Totals
B. typhosus	21	18	1	40
B. paratyphosus A	70	11	20	101
B. paratyphosus B	41	123 (Including inagglutinable paratyphoid strains)	29	193
Inagglutinable paratyphoids	15	—	—	15

SUMMARY OF EXAMINATIONS, WITH RESULTS OBTAINED.

Total number of stools examined	1,921		
Dysentery stools 518: (a) Amœbic	362	(*B. Shiga* 35).	
Dysentery stools 518: (b) Bacillary	69	(*B. Flexner* 23, unidentified 11).	
Stools with Morgan's No. 1 bacillus	21		
Trichomonas infections	57		
Cercomonas	3		
Tetramitus mesnili	4		
Vibrio diarrhœas	47		
Relapsing fever	46		
Malaria	26		
Diplostreptococcal septicæmias	10		
B. coli septicæmia	1		
B. Gaertner infections	1		
B. typhosus	40	(a) Blood culture	21
		(b) Stools, &c.	18
		(c) Agglutination tests	1
B. paratyphosus A	101	(a) Blood cultures	70
		(b) Stools, &c.	11
		(c) Agglutination tests	20
B. paratyphosus B	193	(a) Blood culture	41
		(b) Stools, &c.	123
		(c) Agglutination tests	29
Inagglutinable paratyphoids	—	(a) Blood culture	15
Water tests	14		
Other examinations	491		

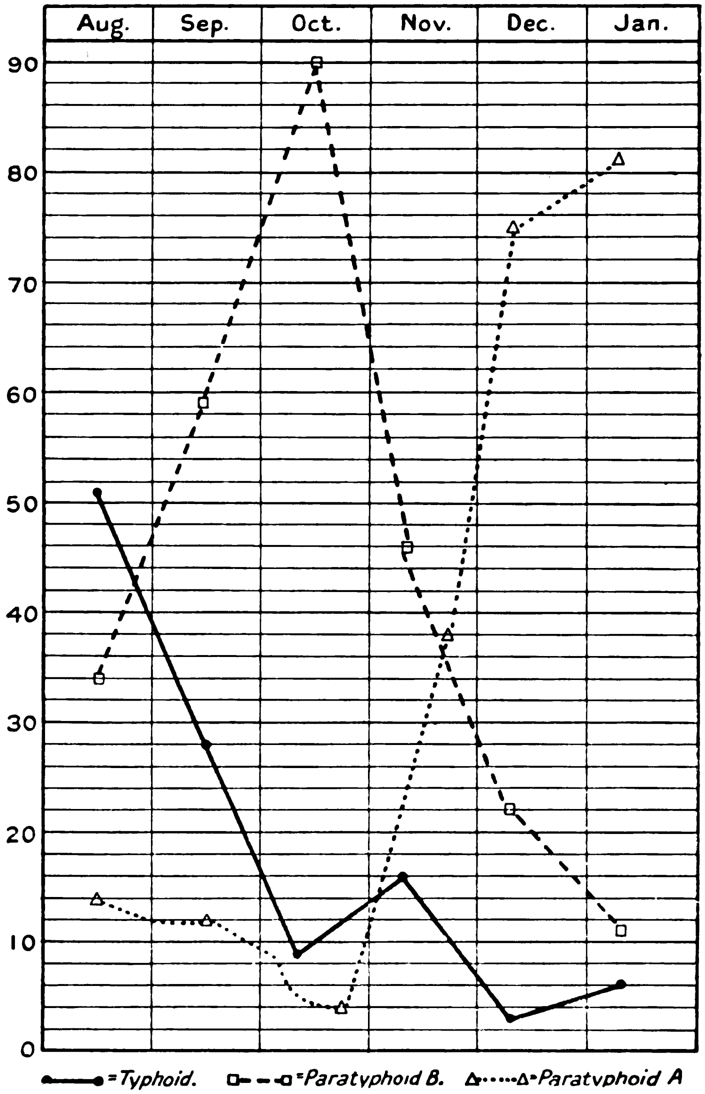

FIG. 1.—Chart representing monthly incidence of typhoid, paratyphoid A and paratyphoid B diagnosed by isolation of their respective organisms.

SUMMARY.

In recapitulation, the following points are emphasized :—

(1) The total typhoid incidence was very low.

(2) The results showed the efficacy of typhoid inoculation against typhoid fever and its inefficacy against paratyphoid.

(3) Blood cultures should always be done in the first week in cases with the symptom group already described.

(4) Attention is drawn to the epidemic of paratyphoid B fever during September and October and the first half of November, and its sudden substitution then onwards by paratyphoid A fever.

Notes from the Cape H. Laboratory by Lieutenant W. Campbell, R.A.M.C.

These notes are intended to indicate in a general manner the results obtained at the Cape H. Laboratory. Unfortunately the bulk of the records were lost during the evacuation, but, while it is now impossible in many instances to give exact figures, the writer still hopes to recover the records eventually, as several interesting details will thereby become available.

Water Supplies.

Under all circumstances, but especially where an outbreak of cholera is a possibility, the purity of water supplied to an army is a *sine qua non*. For this reason much time was spent at the H. Laboratory in the bacteriological examination of water samples.

Chemical analysis was not possible, and reliance had therefore to be placed entirely on the bacteriological examination and inspection of the source of the water and the immediate surroundings of the wells; the results of each of these, on which independent opinions were formed by the bacteriological and by the various sanitary officers, were found to correspond in practically every instance.

In view of the large *B. coli* content of most of the samples examined, this coincidence of opinion is interesting, and will be readily understood when the following facts are explained: The wells at H. were essentially "shallow" wells; the gathering grounds were invariably much polluted by the excreta of horses and mules; the water percolating from these gathering grounds had frequently to pass through a screen of latrine areas on its way through the soil to the wells; in some cases troops had been encamped or entrenched for months close to the mouths of the wells; finally, during the rains surface ground water so overflowed through the mouths of some of the wells in the hollow that the wells had to be pumped free of this water, which was little else than surface washings, before they could be used again.

Having stated these facts, one may proceed to say of unchlorinated samples (i.e., raw water) that in only one case was *B. coli* absent from ten cubic centimetres and smaller amounts of the sample; in a few cases the same organism was present in five cubic centimetres of samples and absent from smaller quantities; in the vast majority of samples, however, *B. coli communis* was recovered from 0·01 cubic centimetre of specimen. The samples were examined immediately they were received at the laboratory, and, usually within two hours of their being taken from the wells.

The cultural characters of an organism having the usual morphological appearances, staining reactions, and cultural features of *B. coli*, had to include the "flagin" group before it was accepted as an "excretal" *B. coli*. As milk was not obtainable, a "flagin" instead of a "flaginac" organism had to be recognized; for the same reason *B. enteritidis sporogenes* was not sought for. On the other hand, the presence of streptococci in some samples decided the question of their potability.

The "total count" by means of gelatine and of agar plates was so high in all the waters that it was found to be of comparatively little help in deciding between one sample and another, and was latterly given up; it was, however, of value in determining whether the process of chlorination as a protective measure had been efficiently carried out.

A keen watch was kept for *V. choleræ asiaticæ;* in no case was it found in any of the samples examined. *B. paratyphosus* B was isolated from one shallow well, within ten yards of which was an old latrine pit. This finding points to the possible water carriage of paratyphoid infections.

Sediments from the bottom of several wells were examined for pathogenic protozoa, parasitic ova, etc., mostly with negative results; but in two instances flagellates with the characters of Trichomonas were found once in a sediment and once in the slime obtained by scraping the wooden beams supporting the sides of a well; flagellates of the type of Cercomonas were found in sediments from three wells.

Note on the Chlorination of Water.

While chlorination was never performed at less than one part per million (available chlorine), chlorination at four parts per million gave the best results, though the water had a decidedly unpleasant taste when chlorine was present in this amount.

Sedimentation (alum five grains to gallon) of some waters followed by chlorination (one part per million), as carried out by Captain W. Egan, R.A.M.C., gave very satisfactory results.

Only four samples of chlorinated water giving bad laboratory results were encountered, and in those the hypochlorite of lime was at fault in not containing the proper amount of available chlorine.

The experience at H. has shown that there can be no question regarding the value of chlorinating doubtful or bad water supplies.

Amœbic Dysentery.

The prevalence of diarrhœal diseases formed one of the largest problems on the Peninsula, and it is no exaggeration to say that Cape H. will ever be associated in the minds of those who were there during the warm weather with the "red flux" of dysentery. Whether or not amœbic dysentery was endemic at Cape H. before its occupation by our troops is not known; even presupposing that it had been, it is quite clear that the source of infection must have been considerably augmented by "amœba carriers" amongst those troops which came from E., where amœbic dysentery is endemic.

At all events, one occasionally saw patients who stated that they had suffered from dysentery in E. before coming to the Peninsula, and that they had been treated there by hypodermic injections—presumably by emetine. Whatever may have been the original focus of infection, troops coming direct from England to Cape H. developed amœbic dysentery.

Working with over 150 cases of dysentery during the months of September and October, one found sixty-five per cent of stools with blood and mucus to contain entamœbæ. A detailed description of the morphology of these entamœbæ would occupy too much space, and an entry into the question of their classification is beyond the scope of this paper. One may say here, however, that as a general rule the ectoplasm of the entamœbæ found was more highly refractile than, and consequently defined from, the endoplasm; the nucleus was exceedingly poor in chromatin and difficult to stain; at times phagocytosis of red blood corpuscles or of bacteria, or of both, was noted; from time to time, cysts definitely with the characters of those of *Entamœba tetragena* were observed. Entamœbæ were also found in some diarrhœic stools in which neither blood nor mucus was present; but rarely in such profusion as in the more typical muco-sanguineous stools of dysentery.

Post-mortem examination of one case, where the patient had

never previously been abroad and had come direct from England to the Peninsula, revealed extensive ulcerative colitis, with the morbid appearances of the type found in amœbic dysentery, together with secondary liver abscess formation—two abscesses being present, one in the right lobe and another, the larger, in the left lobe of the liver; portions of the tissues from this case were sent to Professor J. Lorrain Smith, M.D., F.R.S., for histological examination, and his report stated that the sections showed amœbæ in large numbers.

Bacillary Dysentery.

True bacillary dysentery was rare at Cape H. Plate cultivations succeeded in the recovery of *B. dysenteriæ* (Shiga) from no more than five cases of dysentery; one of these was drawn from S. and so cannot be accounted to Cape H. In one case only was *B. dysenteriæ* (Flexner) isolated.

The cases of bacillary dysentery at Cape H. were sporadic, having no relation to each other either in time or as regards the immediate locality in which they occurred. Further, no epidemic occurred in which the cases were like bacillary dysentery either in their clinical aspects or in their bacteriological findings.

Flagellate Diarrhœas.

Flagellates were found in the stools of a few diarrhœal cases. As they were never found in solid motions this fact would appear to indicate that flagellates were sometimes the cause of diarrhœa. They were at times associated in dysenteric cases with entamœbæ; in one specimen entamœbæ, *Trichomonas hominis* and *B. paratyphosus* B were found in conjunction.

At H. *Cercomonas hominis* and *Trichomonas hominis* were the flagellates more commonly found, Cercomonas rather more often than Trichomonas.

In uncomplicated flagellate diarrhœas, Trichomonas was found to be the responsible agent in eight instances; one case only was due to infection with *Lamblia intestinalis*. Presence of blood in the stools of these cases was the exception and not the rule, blood being found on no more than two occasions, in each case associated with the presence of Trichomonas. The stools of cases suffering from flagellate infections were generally large, watery, diarrhœic stools, containing much fæcal material, and frequently bile, the consistence most often resembling that of thin gruel.

The flagellate diarrhœas were treated with success by the

method recommended by Captain R. G. Archibald, R.A.M.C.; this method consists in the exhibition of a solution of potassium permanganate and in the administration of rectal injections of quinine (strength 1 in 5,000). In two cases where the potassium permanganate was administered in the form of keratin-coated pills and the quinine injections were omitted, very satisfactory results were obtained; this may mean that the permanganate is the agent of chief value.

Typhoid and Paratyphoid Fevers.

(1) *Typhoid Fever.*—Only three patients with true typhoid fever were encountered; in two instances the patient had not been inoculated against *B. typhosus*, while in the third case, where the infection occurred in an inoculated patient, the fever ran a short and abortive course.

There can be no doubt after the H. experience that the practice of antityphoid inoculation has absolutely justified itself.

(2) *The Paratyphoid Fevers.*—In paratyphoid fever one found blood culture between the second and sixth days of the fever to be *par excellence* the best means of diagnosis; of the later stages of the illness one cannot speak, because patients were always removed to the hospital ships as soon as possible and could not therefore be kept under observation by the writer.

Since the thirty cases or so of paratyphoid fever yielding a positive result by blood culture represented approximately fifty per cent of all the cases of P.U.O., thought to be possibly enteric fever, one may conclude, in the first place, that the bacillæmia in paratyphoid fever takes place early, and in the second, that owing to the protection given by antityphoid inoculations, paratyphoid infections are now of greater importance than true typhoid fever as a cause of invaliding amongst the troops.

At H. most of the paratyphoid fever was due to *B. paratyphosus* B. *B. paratyphosus* A and inagglutinable strains were found in a few cases. The inagglutinable strains of paratyphoid bacilli were obtained as follows: once from an ulcer of the ileum and twice from the blood of patients suffering from "jaundice with pyrexia."

B. paratyphosus B was also obtained from the blood of five patients with jaundice; this organism was in another case recovered from the bile of a patient found at operation to be suffering from gangrenous cholecystitis.

Epidemic Jaundice.

Catarrhal jaundice formed the greater portion of the so-called "epidemic jaundice." In view of the prevalence of diarrhœal diseases during the summer months, the relationship between the incidence of these and that of jaundice is interesting; the chart (fig. 3), illustrates this relationship and, for the figures from which he was able to construct it, the writer wishes to acknowledge his indebtedness to Captain MacGregor, R.A.M.C.

Blood cultures were made from sixty-four cases of jaundice; most of these were cases of catarrhal jaundice with slow pulse and normal or subnormal temperature; all of these gave negative results. Cases of jaundice with pyrexia were less frequent, but nine of them gave a positive result, *B. paratyphosus* B being found in five cases an inagglutinable strain of *B. paratyphosus* in two cases, and Gram-negative motile non-lactose-fermenters (which could not be worked out owing to the evacuation) in two cases. One of the last-mentioned organisms gave the cultural reactions of *B. paratyphosus*, but for the reason above stated, the agglutination tests against the paratyphoid anti-sera could not be carried through.

In these cases of positive blood culture one gained the impression that the jaundice and the paratyphoid fever were concomitant infections; further, no evidence was obtained of the jaundice being due to a specific micro-organism.

Simple Diarrhœas.

Lienteric diarrhœas unattended by pyrexia or, as in a few cases, associated with an elevation of temperature not exceeding two degrees above normal, in which many large watery motions containing neither blood nor mucus were passed *per diem*, were present at H. in the warm weather; these diarrhœas became suddenly rare early in October when the days became colder.

Although a quickened pulse-rate was common, the simple diarrhœas were not, as a rule, accompanied by any further symptoms other than occasional colic; for this reason they gave little rise for anxiety except, perhaps, as possible predisposing causes for dysentery and cholera. These diarrhœas usually lasted ten days, with an average duration of three to five days.

In a group of twenty cases which were examined bacteriologically there was in no case any infection with bacilli of the dysenteric or typhoid groups of micro-organisms, nor with entamœbæ, flagellates, or spirochætes.

Compared with films from normal fæces and with similar films from cases of dysentery, direct preparations from the stools in the simple diarrhœas revealed a remarkably heavy organismal infection, not due to any of the micro-organisms usually recognized as capable of producing diarrhœa.

In one exceptional case with choleraic symptoms, vibrios were noted, but these did not prove to be *V. asiaticæ choleræ*.

In two cases a diplococcus was found to be the predominating organism, and, on plating out the specimens, colonies of this organism, whose growth was not inhibited by either McConkey's or Endo's medium, greatly outnumbered the colonies of all other organisms, present; on further examination, the organism was found to correspond with the diplo-streptococcus already referred to above. A similar organism was also encountered during the month of December in a more chronic case of diarrhœa, where the patient had suffered from diarrhœa at frequent intervals for several months but had never passed blood or mucus; and where no cause, except the diplostreptococcus, could be found on bacteriological examination of several specimens of the stool. Some believe the acute simple diarrhœas to have been due to the mechanical action of sand in the intestine. The writer was informed by one regimental medical officer that he had observed after each sand-storm an apparent increase in the number of diarrhœal cases with which he had to deal; this, however, was not the experience of others.

Sand *per se*, either taken in the food or swallowed directly during a sand-storm, can be accepted as an important factor in the causation of the simple diarrhœas. More positive evidence is required of its presence in intimate mixture with the fæces, because sand particles are not an uncommon form of adventitious contamination of specimens of fæces sent to a laboratory during a sand-storm.

In some cases where the patients had been on the Peninsula for no more than two days, and that in non-windy weather, sand could not have been a serious ætiological factor. Further, if the diarrhœas were caused so largely by sand, one would have expected colic to have been a more prominent feature of them.

While the purely irritative action of sand may be regarded as a somewhat doubtful adjuvant in the production of diarrhœa, the question of micro-organismal infection conveyed indirectly to the patient by means of soiled sand used in cleaning out mess-tins, etc., is quite another matter; it is common knowledge that epidemics of camp diarrhœas have been caused in this manner.

With other causal factors apparently constant, the remarkable coincidence of a marked diminished incidence of the diarrhœal diseases with a sudden fall in the temperature and an arrest of the fly-plague was striking and serves to show that the relationship existing between them was very real. At the latrines flies formed a perfect plague, and it was no difficult matter to understand how noxious material could be carried by them from the latrine to food; the latter was frequently covered by flies to such an extent that it became a veritable black mass of living things. Aided by the warm weather, this would result in a multiplication many times over of the original organismal infection of the food. It would seem that most of the simple diarrhœas were due to a "mass infection" obtained in this way—a mass infection probably capable of producing diarrhœa although the individual strains of organisms concerned need not necessarily have had a specific pathogenic action.

This is borne out by the heavy organismal infection found in the stools of these cases, by the absence of specific infection by dysenteric or typhoid organisms, and, if the analogy of summer diarrhœa in children be taken by its consonance with certain investigations in America, where it was shown that a massive infection conveyed by means of milk could in the ordinary way inevitably produce diarrhœa, although of 200 strains of organisms isolated from the same milk none had by itself a specific pathogenic function.

While this opinion is expressed, an open mind must be kept as regards the rôle of vibrios and of the diplostreptococci already referred to; these may play a more important part in the production of such diarrhœas as were common during the hot weather than the limited number of examinations carried through at H. might indicate.

Malaria.

Patients suffering from malarial fever were met with from time to time. Of these, four cases had undoubtedly become infected (benign tertian) at Cape H., a fact which is interesting in view of Lieutenant-Colonel Balfour's discovery of *Anophelinæ* there.

Diphtheria.

This disease was not unfrequently met with. The most noteworthy facts are these:—

(1) The open-air life rendered the disease a mild type clinically.

(2) One case of exceptionally mild sore throat bacteriologically diagnosed as, but clinically unlike, diphtheria, revealed its true clinical position at a later date by the development of neuro-cardial paralysis.

(3) The disease was apparently spread by "carriers." Two "diphtheria-carriers" were detected; their isolation was followed by a diminished incidence of the disease amongst the troops of the regiment from which they came.

(4) As no raw milk was used by the troops—tinned milk only being made use of—this article of diet could be excluded as a means of spreading the disease, a fact which emphasizes the importance of the "carrier."

Pneumococcal Throat.

While ordinary septic throats and diphtheria were the most common throat conditions, mention should be made of the fact that, with the sudden advent of a short period of cold, damp weather, numerous cases of tonsillitis and pharyngitis occurred.

In these cases the temperature continued high for several days, and, while no suppuration occurred, the effect of this variety of sore throat upon the patient's general condition was more profound than might have been expected from the appearance of the local lesion.

The pneumococcal throat is a specific entity, and the likelihood of its occurrence should be borne in mind, particularly when the weather conditions are changing from warm to cold and damp.

To assist in its bacteriological investigation it would be well to employ blood agar for the primary cultures in addition to the routine blood serum or egg medium.

Gallipoli Sore.

The so-called Gallipoli sore was that variety of septic or trench sore which was common amongst the troops on the Peninsula. The lesions were divisible into primary and secondary—the primary being traumatic ulcers and the secondary being vesicles, which later developed into ulcers simulating those of the primary lesions. The favourite sites of the primary lesions were the posterior aspects of the fingers and the dorsal metacarpal areas of the hands; while those of the secondary lesions were both aspects of the forearms and hands, though the upper arms and the lips were by no means immune.

Patients commonly described a slight injury to the skin occurring during trenching operations as the cause of the primary lesion or lesions, though this history was not obtained invariably, some patients believing that they owed the condition to bites from flies; in most cases the history of traumatism was clear.

In the majority of cases the primary lesions—indolent ulcers, taking anything between two weeks and three months to heal—were followed intermittently by the appearance of vesicles (the early secondary lesions) on the hands and arms. These vesicles generally contained a serous exudate, though some vesicles with sero-purulent or with sero-sanguineous contents could often be found; if protected from injury the vesicles occasionally terminated by simple resolution. Their usual termination, however, was rupture by traumatism during washing or in some such way, and when this happened a superficial ulcer was formed, the base of which sloughed off within the next day or two, leaving an indolent ulcer similar in characters to that of the well-developed primary lesion. Lymphangitis and lymphadenitis were rare, only being seen in those infrequent cases where an acute septic infection arose as a complication.

The only organism constantly present in the lesions was a Gram-positive diplococcus which could always be obtained on culture as well as demonstrated in direct preparations from the sores and vesicles. In the open lesions this organism was associated with one or more of the following: *Staphylococcus pyogenes albus* and *aureus*, streptococci, diphtheroid bacilli, leptothriceæ, aspergillus and other hyphomycetes, *Bacillus subtilis; but from the closed lesions (vesicles) properly taken material yielded only the Gram-positive diplococcus*. For this reason the diplococcus is regarded as the essential factor in the causation of Gallipoli sore. In films taken from vesicles within the first three days of their development the diplococci were both intracellular and extracellular, while in films from vesicles of longer standing they were usually extracellular. No capsules could be demonstrated, although in some preparations occasional diplococci were seen to be definitely aureolated.

On culture, these diplococci grew best on blood agar, forming small greyish colonies with smooth margins; most strains had no hæmolytic action, but in one or two instances the organism did possess feeble hæmolytic powers. In direct films and in preparations from young cultures the typical organism was seen to be made up of two elongated, somewhat reniform cocci, which had their opposed edges flattened, on culture however, involution

occurred readily, the flattened cocci becoming swollen and spherical —the component parts of the diplococcus sometimes swelling unequally; similarly, after cultivation of the organism for forty-eight hours or longer, short streptococcal forms were frequently seen—but since in the unbroken vesicles the only forms found were diplococcal, the term "streptococcal dermatitis," as applied by some to the condition, does not fairly describe "Gallipoli sore" in so far as its ætiology is concerned.

The main points referred to in the reports may be briefly summarized:—

(1) The type of dysentery most prevalent among the troops in the Dardanelles in August, September and October was amœbic; only a few cases of bacillary infections occurred during these months.

In November, December and January, amœbic dysentery entirely disappeared, and the incidence of the bacillary type of the disease increased.

(2) The diarrhœa incidence was greatest during the months when dust and flies were prevalent. Many cases apparently were not due to any specific organism, but resulted from a "mass infection" of micro-organisms in the intestinal tract.

Diplo-streptococci, vibrios, Morgan's No. 1 bacillus and *T. intestinalis* appeared to be causal agents in a certain percentage of cases.

(3) The typhoid incidence among the troops was very low, the majority of the enterica infections being represented by fevers of the paratyphoid group.

Paratyphoid B was more prevalent in September and October, whereas in the following months paratyphoid A was more commonly met with.

There can be little doubt that the "carrier" plays an important part in the dissemination of paratyphoid fever, assisted probably by such agents as flies and dust. At the same time the possibility of its being a water-borne disease should also be considered. Antityphoid inoculation apparently confers no immunity against paratyphoid.

(4) Relapsing fever was found affecting chiefly I. troops and men of the E. Labour Corps. Clinical and laboratory observations indicate that two distinct species of spirochæte were concerned, and that the body-louse was apparently the transmitting agent.

(5) No conclusions were arrived at regarding the ætiology of epidemic jaundice. In apyrexial cases blood cultures yielded

negative results, whereas in cases associated with pyrexia *B. paratyphosus* B was occasionally present in the blood, probably as a concomitant infection.

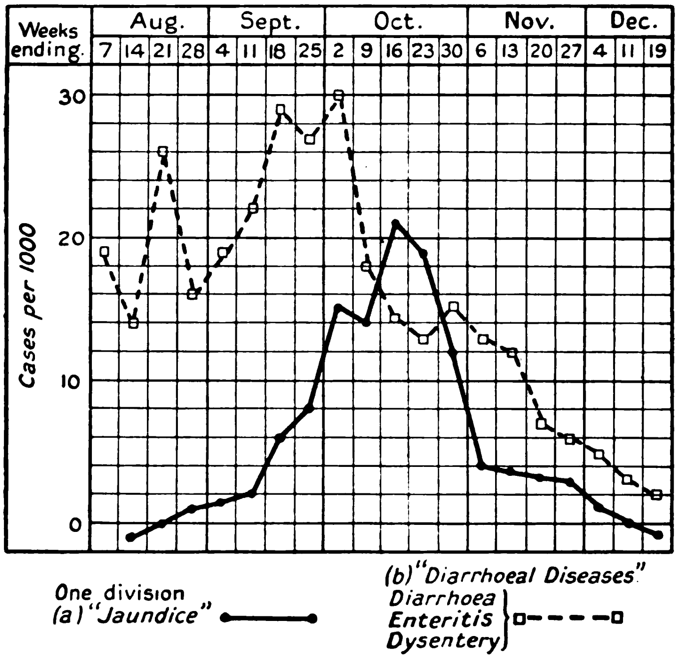

Fig. 2.—Chart showing the incidence-rate of epidemic jaundice and diarrhœal diseases per 1,000 troops in one division for period August 7 to December 19, 1915.

ACKNOWLEDGMENTS.

Thanks are due to Lieutenant-Colonel Willcox, R.A.M.C., and to the O.C.'s and officers of —— stationary hospitals and field ambulance, and medical officers of the E. Labour Corps for kindly assisting the laboratories in obtaining pathological material.

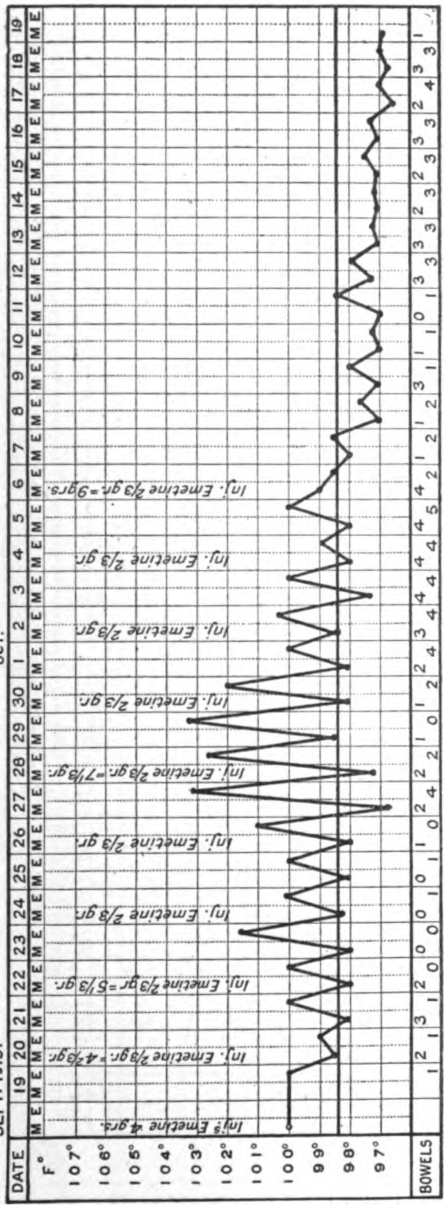

Fig. 3.—Amœbic dysentery, treated with emetine.

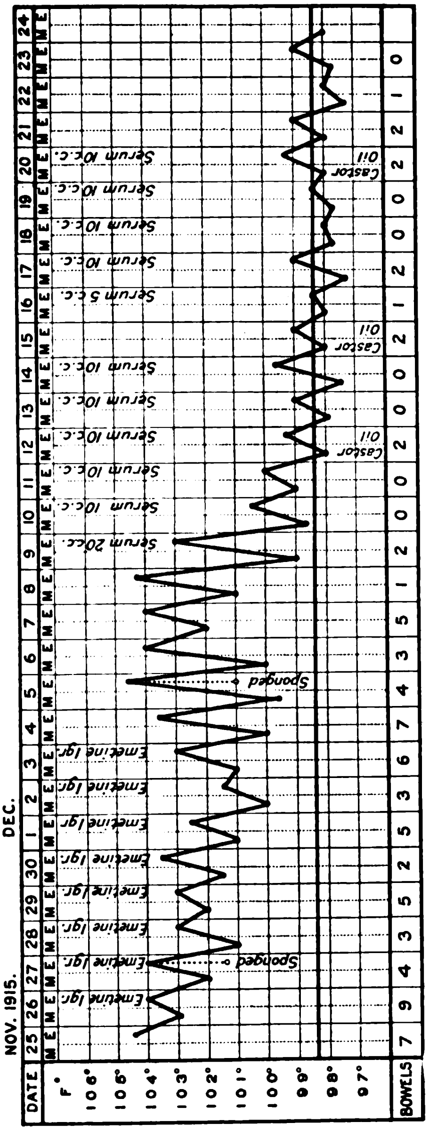

Fig. 4.—Bacillary dysentery (*B. Flexner*). This case was treated with emetine prior to bacteriological investigation. On the thirteenth day *B. Flexner* was isolated rom the stools and serum treatment was employed with striking success.

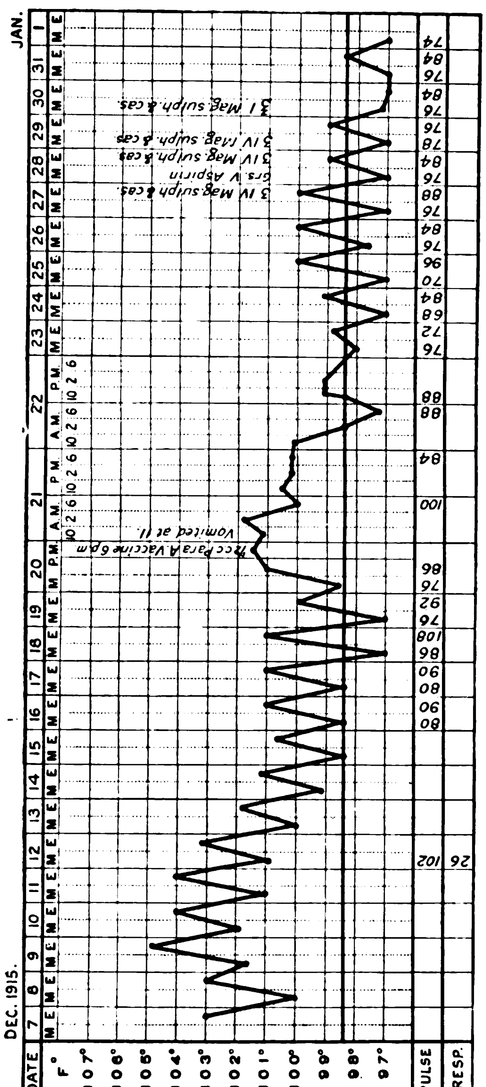

FIG. 5.—Chart of paratyphoid A fever.

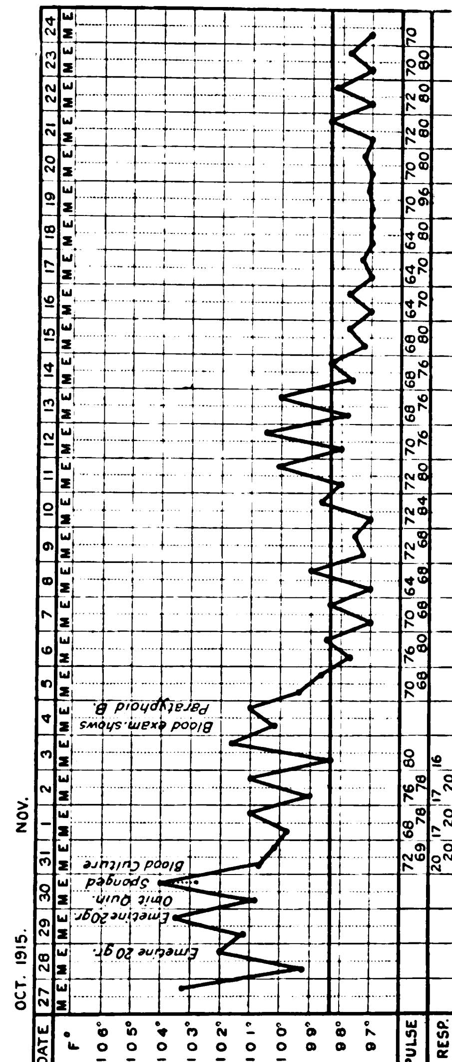

FIG. 6.—Chart of paratyphoid B fever.

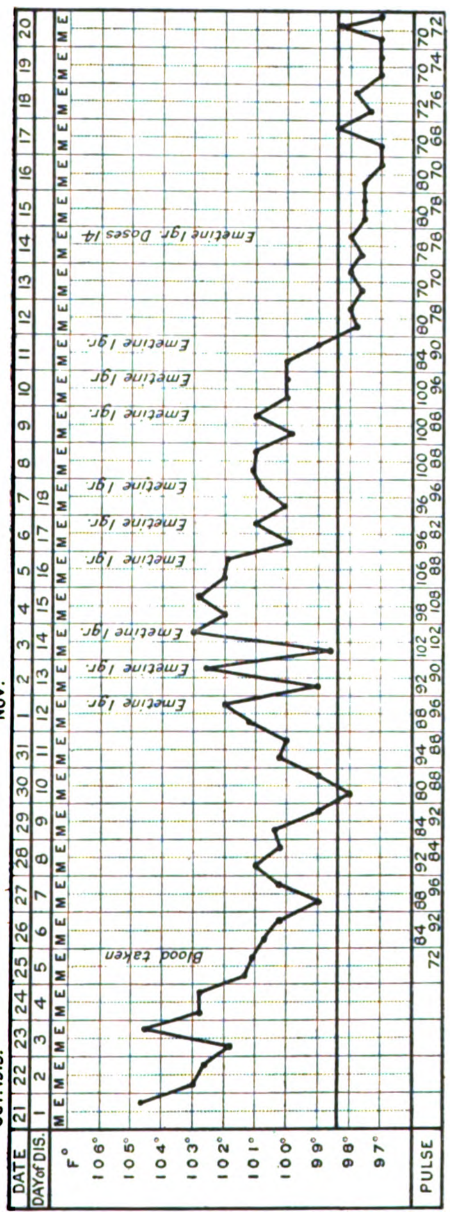

Fig. 7.—Chart of paratyphoid B fever complicated by amœbic dysentery.

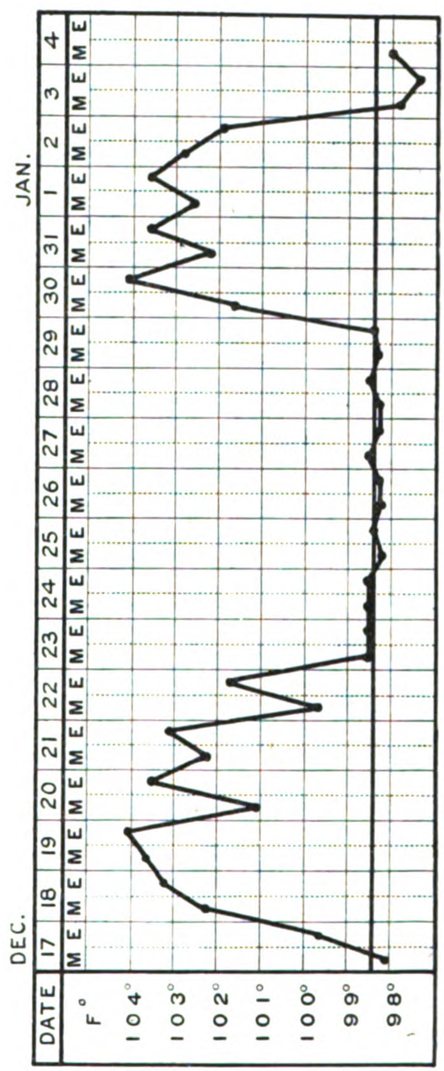

Fig. 8.—Relapsing fever (Indian).

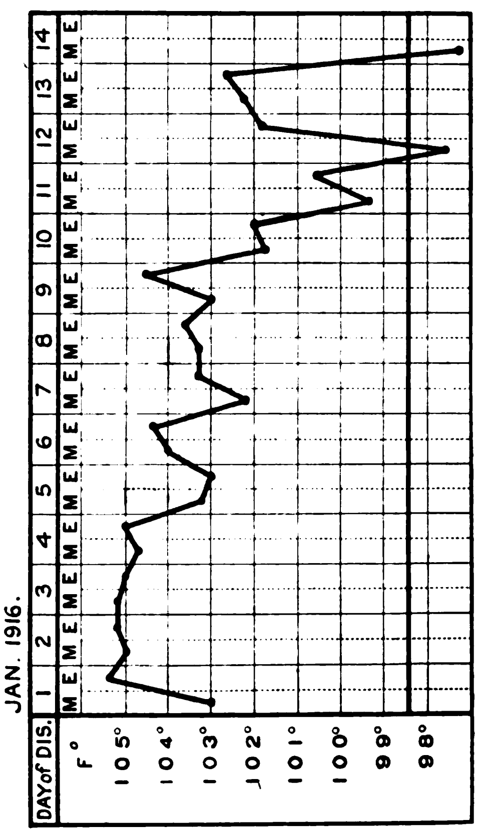

FIG. 9.—Fatal case of relapsing fever (Egyptian).

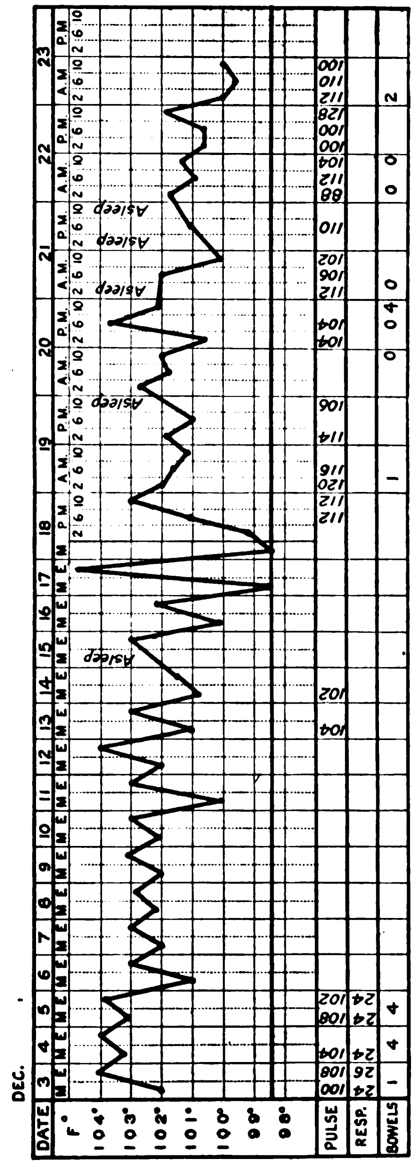

FIG. 10.—Case of frostbite complicated with typhoid. *B. typhosus* was obtained from the local lesions in the right foot, where a suppurative osteo-arthritis had occurred.

SOME EXPERIMENTS WITH THE SERVICE RIFLE AT CLOSE RANGE.

By Colonel W. H. WILLCOX, M.D Lond., F.R.C.P.Lond.
Army Medical Service.

The following experiments were carried out with the ordinary Service rifle and ammunition. Targets of white cardboard at distances from the muzzle of 3 inches, 6 inches, 9 inches, 12 inches, 18 inches and 24 inches respectively were used. Also targets of new chamois leather gummed on white cardboard were employed, the distances in the latter case being 1 inch, 3 inches, 6 inches, 9 inches, and 12 inches. The cartridges were of two types: (*a*) English, (*b*) American.

In the former the explosive was cordite, the threads of which are closely packed longitudinally in the case of the cartridge.

In the latter the explosive was a nitro-cellulose powder. This powder was of a steel-grey colour, and consisted of short cylindrical pieces, about $\frac{1}{16}$ inch long, and small diameter. The cartridges were marked U15.VII on the base of the case. The experiments are of importance, since they indicate the signs to be looked for in the case of wounds on the bare skin at close range. In the important decision of whether a wound is "self-inflicted" or not, the diagnosis of the range—i.e., the distance of the muzzle from the body—is of great moment.

(A) English Ammunition (Cordite).

I.—*Targets of White Cardboard.*

(1) *Distance from Muzzle equals Three Inches.*—No burning of the cardboard occurred. There was some blackening over an area of five inches by five inches, but this was superficial in character and could to some extent be wiped off with a damp cloth. The bullet hole was a small round hole corresponding to the size of a bullet. The tattooing—i.e., the marks from unconsumed powder—occupied an area two inches by two inches round the bullet hole. It was superficial in character and consisted of a number of small lines about $\frac{1}{20}$ inch long.

(2) *Distance from Muzzle equals Six Inches.*—In this case very faint blackening occurred, which can readily be wiped off with a

damp cloth. The bullet hole was a small round hole corresponding to the bullet. The tattooing occupied an area three inches by three inches. It was superficial in character, and consisted of small longitudinal lines of length from $\frac{1}{30}$ inch to $\frac{1}{4}$ inch.

(3) *Distance from Muzzle equals Nine Inches.*—No blackening occurred. Bullet hole as before. Tattooing was slight, it occupied an area of four inches by four inches, and consisted of a few longitudinal lines of maximum length $\frac{1}{4}$ inch, some of the marks being mere points. It was very superficial in character.

(4) *Distance from Muzzle equals Twelve Inches.*—No blackening occurred. Bullet holes as before. The tattooing occupied an area $6\frac{1}{2}$ inches by $6\frac{1}{2}$ inches. It consisted of some very superficial marks, some of which were longitudinal, about $\frac{1}{3}$ inch long; but most of them were much shorter, some of them being mere points.

(5) *Distance from Muzzle equals Eighteen Inches.*—Bullet hole as before. No blackening occurred. Tattooing almost absent. It consisted of four superficial longitudinal marks about $\frac{1}{3}$ inch, $\frac{1}{4}$ inch, $\frac{1}{8}$ inch, $\frac{1}{10}$ inch long, within three inches of the bullet hole.

(6) *Distance from Muzzle equals Twenty-four Inches.*—Bullet hole as before. No blackening. Tattooing of very slight character. A few faint dots or lines in an area three inches by three inches around the bullet hole.

II.—*Chamois Leather Targets.*

(1) *Distance from Muzzle equals One Inch.*—The chamois leather was torn away round the bullet hole for a distance of one inch by one inch. Slight scorching of the leather occurred. There was marked blackening over an area two inches by two inches. The tattooing consisted of slight marks immediately around the bullet hole.

(2) *Distance from Muzzle equals Three Inches.*—Bullet hole consisted of a small round hole the size of the bullet. Tattooing was slightly marked and consisted of a few faint impressions in an area $1\frac{1}{2}$ inch by $1\frac{1}{2}$ inch around the bullet.

(3) *Distance from Muzzle equals Six Inches.*—Very faint blackening occurred in an area $1\frac{1}{2}$ inch by $1\frac{1}{2}$ inch around the bullet hole. Tattooing was of such a slight character as to make scarcely a mark on the leather.

(4) *Distance from Muzzle equals Nine Inches.*—No blackening occurred. Tattooing was of such a slight character as to be practically unnoticeable.

(5) *Distance from Muzzle equals Twelve Inches.*—No blackening occurred. Tattooing was unobservable.

(B) American Ammunition (Nitro-powder in Short Rods.)

I.—*Targets of White Cardboard.*

(1) *Distance from Muzzle equals Three Inches.*—No burning occurred. Blackening occurred over an area nine inches by nine inches. It was more marked than in the case of cordite explosive. Tattooing was marked and occupied an area three inches by three inches around the bullet hole. It consisted of a number of small dots.

(2) *Distance from Muzzle equals Six Inches.* — Blackening occurred over an area of six inches by six inches. Tattooing was marked. It consisted of a large number of small points occupying an area of five inches by 5 inches around the bullet.

(3) *Distance from Muzzle equals Nine Inches.*—Faint blackening occurred over an area of six inches by six inches. Tattooing was marked and consisted of a large number of small points occupying an area 5½ inches by 5½ inches round the bullet hole.

(4) *Distance from Muzzle equals Twelve Inches.*—Blackening was extremely faint. Tattooing was marked, and consisted of a number of small points occupying an area of six inches by six inches round the bullet hole.

(5) *Distance from Muzzle equals Eighteen Inches.*—No blackening occurred. The tattooing was slight, and consisted of about twenty isolated tiny marks occupying an area six inches by six inches around the bullet hole.

(6) *Distance from Muzzle equals Twenty-four Inches.*—No blackening and no tattooing occurred.

II.—*Chamois Leather Targets.*

(1) *Distance from Muzzle equals One Inch.*—Slight scorching occurred around the bullet hole. Blackening was very marked, occupying an area of four inches by four inches around the hole. Tattooing was marked in an area 1½ inch by 1½ inch around the bullet hole. In one experiment the disruptive effect of the discharge was so great as to split the chamois leather and to tear it away from the cardboard on which it was gummed.

(2) *Distance from Muzzle equals Three Inches.*—No scorching occurred. Blackening was marked over an area of six inches by six inches. Tattooing was marked, and consisted of a number of

small points occupying an area $2\frac{1}{2}$ inches by $2\frac{1}{2}$ inches round the bullet hole.

(3) *Distance from Muzzle equals Six Inches.* — Blackening occurred in an area six inches by six inches round the bullet hole. It was not marked. Tattooing occurred and consisted of a few faint marks in an area of three inches by three inches around the bullet hole.

(4) *Distance from Muzzle equals Nine Inches.*—Faint blackening occurred over an area of four inches by four inches around the bullet hole. Tattooing was of a very slight character, and consisted of a few superficial points in an area of four inches by four inches around the bullet hole.

(5) *Distance from Muzzle equals Twelve Inches.*—Blackening was of an extremely faint character in an area of $4\frac{1}{2}$ inches by $4\frac{1}{2}$ inches around the bullet hole. Tattooing consisted of a few very faint superficial marks which were scarcely noticeable.

Conclusions.

(1) In all bullet wounds produced at close quarters it is of the utmost importance that any signs of blackening, scorching, or tattooing should be carefully looked for before the wound is surgically cleansed. Notes as to these conditions should be made at the time.

(2) It is essential that the type of ammunition used should be known. This can generally be determined by the mark on the cartridge case.

(3) The chamois leather experiments probably represent fairly closely the conditions that would be obtained on human skin.

(4) *With cordite ammunition* some blackening occurs up to a distance of six inches, but on human skin it would probably be easily washed off. Tattooing with cordite ammunition on human skin would be of an extremely slight character. Up to a distance of one inch tattooing would be not noticed owing to the disruptive effect of the discharge. From one to three inches it would be very slight. Beyond three inches it would be unnoticeable.

(5) With American ammunition (nitro-cellulose powder in short rods) on human skin blackening would occur up to a distance of nine inches, though it might be readily washed off. Up to a distance of one inch tattooing would not be noticed owing to the disruptive effect of the discharge. From one inch to six inches

tattooing would be shown by slight marks on the skin around the bullet hole.

For valuable help in conducting the above experiments, my thanks are due to Mr. E. I. Churchill, gunmaker, of 8, Agar Street, London.

The effects produced by pistol wounds with nitro-cellulose powder and ordinary gun powder at close ranges are dealt with in a paper, "The Medico-legal Importance of Wounds produced by Fire-arms," *Transactions of the Medico-Legal Society*, 1907-08, by W. H. Willcox.

THE PRINCIPLES OF TREATMENT IN GUNSHOT WOUNDS OF THE HEAD.[1]

By Colonel C. A. BALLANCE, M.V.O., M.S.
Army Medical Service.

Two months ago Colonel Purves Stewart gave us an exhaustive and lucid address on the diagnosis of gunshot wounds of the head. He commenced his address by referring to the anatomy and physiology of the brain, and laid especial stress on the localization of motor and sensory function in the cerebral cortex. A knowledge of the representation of function in the cerebral cortex combined with accurate clinical observation is the key which opens to us a clear knowledge of the injury received by the soldier. For the treatment of cases of gunshot wounds of the head, the surgeon must be familiar with the neurological methods of clinical examination or must be associated in the treatment of the case with a physician with neurological experience. For, as Tennyson says—

> " 'Tis the blot upon the brain
> That will show itself without."

We, in this island, have the supreme advantage of the assistance of Colonel Purves Stewart, who has won for himself by study and immense industry a position in neurology which is not excelled by any living person.

When I was a student the great doctrine of the localization of function in the brain was unknown, or only doubtfully accepted. Sir David Ferrier's first paper on the subject was published in 1873. Few took any notice of it. It was only many years later that its value was recognized. When this paper was published Sir David Ferrier was a medical officer at the West Riding Lunatic Asylum.

In the Physiological Section of the International Medical Congress, held in London in 1881, there was an Homeric contest of transcendent moment to the advancement of knowledge and vital to the interests of mankind. A dog was shown by Professor Goltz, and two monkeys were exhibited by Professor Ferrier. I was then recently qualified and I was present at this meeting.

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[1] A paper read at a meeting of the Conference of Medical Officers of the Malta Command, held in the Council Chamber of the Valletta Palace (by kind permission of His Excellency the Governor), on December 17, 1915.

Experimental injuries had been inflicted on the cerebral cortices of the dog and the two monkeys. The condition of the dog was supposed by Goltz to prove that localization of function in the cerebral cortex did not exist. One of the monkeys was typically hemiplegic, having lost power in the arm and leg. Professor Charcot remarked as the monkey came into the room: "It is a patient." The other monkey showed no signs of hearing when a percussion cap was snapped in its immediate vicinity—indeed, it was the only animal in the room that did not jump when the explosion occurred. Its auditory cortical centres had been destroyed by the Paquelin cautery on both sides of the brain.

In 1884 Sir David Ferrier delivered the Marshall Hall Oration, and in it made a forecast of the surgery of the nervous system (which was then non-existent), which has since been amply justified. He said "that up to that time cerebral localization had been absorbed like latent heat by medical science itself, as distinct from medical and surgical practice, but that the unfailing safety of experiments on animals made it clear that similar results would soon be achieved on man himself." It is indeed true that the surgery of the nervous system has shared in the great advances which have been made during the last thirty years in all departments of surgical practice. Despite the statements about German Kultur we may be proud of what Britain has contributed to neurology. The late Sir Theodore Martin a few years ago, expressing his views on the signs of the times, wrote :—

"Where are the giants? Where are the Palmerstons, the Disraelis, the Gladstones in politics? Where are the giants in literature? Where in any walk of life are alpine altitudes to be found?" As far as neurology is concerned, we can answer this question. Where in any country or in any time can we find a quintette of names of alpine altitude in neurology such as we can produce in Hughlings Jackson, Gowers, Ferrier, Beevor and Horsley?

Compound fractures of the skull have been accidents familiar to the human race as long as the race has existed on this planet. I remember the time well that "when the brains were out the man would die, and there an end," and, alas! this dire calamity still dogs our footsteps. Some compound fractures of the skull with injury to the brain seem to have been recovered from during all periods of man's known history, and Shakespeare, who appears to have known nearly everything, must have had experience of such compound fractures of the skull, for he writes :—

> " . . . . Strangely visited people,
> All swollen and ulcerous in the brains,
> The mere despair of surgery he [the surgeon] cures."

Only a very small proportion of gunshot injuries of the head ever reach a base hospital. If the bullet traverses the head the brain, which is of liquid texture, allows of the force being distributed in every direction, and the soldier will die of arrest of respiration quite independent of other conditions such as hæmorrhage. It has even been proposed that under these circumstances artificial respiration should be performed, I suppose by medical officers on the field of battle; but this is hardly practical advice.

Celsus wrote 2,000 years ago, and nothing that has ever been written is more true: "Whenever there is an injury from which survival is possible, the immediate indications are two in number: to see that neither hæmorrhage nor inflammation terminates life."

We have all seen in Malta the types of injuries inflicted on the skull and brain by gunshot wounds. Let me enumerate them:—

(1) *Wound of the Scalp, with or without Exposure of Bone, with Contusion of Brain, the Skull not being Fractured.*—In one such case of wound of the scalp of the left occipital region, not exposing the skull, the patient had hemianopsia, and becoming drowsy a left occipital craniectomy was performed. There was no fracture of the skull, but the cancellous tissue between the inner and outer tables of the skull was full of blood, which was extravasated also inside and outside the dura mater. The occipital lobe was completely pulped. The man made a good recovery.

(2) *Wound of the Scalp with Fissure Fracture of the Skull.*—These are always dangerous because the scalp wound is so infective. In one such case with fissure fracture in the left temporal region the soldier had aphasia, but gradually improved, then became more aphasic and drowsy. Operation was performed and a large amount of bone had to be removed because not only was there a collection of pus beneath the skull, but the cancellous tissue of the bone was infected. An osteomyelitis of the cranial bones in the neighbourhood of the fissure had commenced. This spreads rapidly, is called osteomyelitis inveterata by French writers, and all infected bone must be removed. This soldier recovered.

(3) *Wounds of Scalp with Gutter, Depressed, or Punctured Fractures are very Numerous.*—The inner table of the skull is apt to be much more seriously damaged than the outer.

(4) *Massive Fractures of the Skull with much Comminution, but not necessarily wide Laceration of the Brain.*

(5) *Much Comminution of the Skull, and much Damage to the Brain.*

(6) *Cases in which Bullets which enter the Skull Traverse the Brain and do not Escape.*

(7) *Through-and-through Injuries are rarely recovered from unless they are from side to side in the Frontal or Occipital Regions.*— I remember, however, seeing an officer who was shot through the head at Pieter's Hill. The bullet entered the lower part of the forehead and escaped below the external occipital protuberance behind. He was nearly buried alive, as the serjeant thought he was dead. He was for fifteen days completely unconscious. When I saw him some months afterwards, I could detect nothing wrong with him except total deafness in one ear. He complained also of occasional headaches.

The destruction of brain tissue may not be great. It is well to remember that cerebral cells and cerebral nerve-fibres cannot be repaired. There are no neurolemma cells around the cerebral nerve fibres. The opposite uninjured cerebral hemisphere is not of much use in taking the place of the damaged hemisphere. Lacerations and damage to the cerebral substance are often recovered from, but they leave a legacy behind them which may prove a lifelong disablement—I refer to epilepsy, palsy, contractures, change in character, and other distressing nervous disorders. The wonderful experiments of Carrel and Guthrie on the anastomosis of vessels has made it possible to carry out successfully the transplantation of organs; indeed, for example, the kidneys have been successfully transplanted. We cannot—

> ". . . look into the seeds of Time
> And say which grain will grow and which will not."

There are many events in the womb of time which have yet to be delivered. The advance of surgery may make possible things unattempted yet. At some future time it may be possible to treat severe injuries and diseases of the brain by transplantation. But if this comes to pass, from whence, may I ask, are we to obtain the brain tissue for the transplant? The higher apes, the chimpanzee and the gorilla are getting scarce. Perhaps the famous cellar of Mark Twain may come in useful. You remember that he had a notice over his cellar to this effect : "To medical students, experimenters and others. Take notice, a select variety of hardened criminals, assorted vagabonds and other undesirables always on hand for sale on reasonable terms."

Now the question arises, What would happen if my colleague, Colonel Charters Symonds, were to replace the damaged brain of a philanthropic old gentleman with the brain of a young and strong assorted vagabond? Would the patient still be philanthropic or would the vagabond brain assert its pre-eminence? These transplantations would have to be done in a minimum of time or the brain cells of the living vagabond brain would suffer, as is shown by the following experiment:—

When I was in Cleveland, Ohio, some years ago, I witnesed a wonderful experiment by Professor Crile. Two large dogs were anæsthetized and the common carotid of each dog was dissected clear of all tissues. The carotid of one dog was then cut across and the animal was allowed to bleed to death. When death had taken place the proximal portion of the carotid of the living dog was united by suture end to end with the proximal portion of the carotid of the dead dog. The blood was allowed to flow from the living to the dead dog thirty-five minutes after the dead dog was dead. The dead dog's heart immediately began to beat, and in another half an hour both dogs were running about the laboratory as if nothing had happened to them. Professor Crile told me that it was very important not to take longer than forty minutes in doing this experiment, as if the dead dog was brought to life again after a longer period than forty minutes its character was always profoundly changed, this change in character being due to anatomical changes easily demonstrated by the microscope in the cerebral cells.

I must tell you another story. During the South African War I was a member, with many other London surgeons, of the Duke of Abercorn's Committee for looking after wounded officers. Our business was to operate without fee, thanks, or other reward. I used the living nerves of the ox and sheep on several occasions to bridge over wide gaps in large nerves. The Duke asked me why I did not use dogs' nerves for the transplant? Before I could reply he said: "Oh! I suppose if you transplanted a dog's nerve into an officer's leg he would have raised it afterwards whenever he passed a lamp post, and the War Office would not approve."

I have already mentioned the great mortality of gunshot wounds of the skull before the soldier reaches the base hospital. At the base hospital, such as this island is, the number of fatal cases is also considerable. To-day we have to consider how this mortality may be lessened. It is up to us, as the saying is, to win our way "on the bank and shoal of Time" to clearer knowledge and more successful treatment of these terrible injuries. It is no use being

depressed, for, as Cæsar said of war, so we may also say of the surgeon who has to treat gunshot fractures of the skull: "He makes a great mistake who thinks that all his operations will be successful."

At the Front the need for operation is only clear and imperative in quite a small proportion of cases; and apart from the cleansing and disinfection of the scalp the cases that have done best with us are those which have not been operated on at the clearing station or the hospital ship. The clinical condition of the patient shortly after being hit and, indeed, for some days afterwards may bear no relation to a gross lesion of the cerebral substance, but may depend on concussion, shock, local œdema, contusion, etc., or other factors which are *temporary in nature* and for which no operation is required.

A cardinal fact in all these cases of head injury when they reach Malta is that the scalp wound is foul and suppurating, and when the skull is broken a compound, often comminuted, fracture bathed in pus presents itself for treatment. There is nothing peculiar about these fractures. The more clearly we recognize this fact, and the more closely we design the treatment of these head injuries on the lines of those fundamental principles of surgery which we know can be successfully applied to the treatment of foul compound fractures in other parts of the body, the more likely are we to accomplish the best result for our patient. Now, what are these fundamental principles?

(1) The cleansing of the wound and the skin around the area of operation.

(2) The inspection of the site of the injury by enlargement of the wound.

(3) The arrest of hæmorrhage.

(4) The removal of loose bone fragments and the removal also possibly of a bullet or metal fragments.

(5) The provision of free, unhindered spontaneous drainage:—

> "Wounds by wider wounds are healed,
> And poisons by themselves expelled."

(6) The after-treatment by dressings and irrigation, etc.

Our patient, as soon as convenient after careful clinical and X-ray examinations have been made, should be taken to the theatre and if necessary anæsthetized. The head should be washed with ether soap, shaved, wiped over with ether or turpentine, and then, if desired, the two per cent solution of iodine may be applied. The

most careful effort should be made to asepticize the scalp. This is an important part of the surgeon's duty, and it should not be left to be done by an orderly, for upon the success of this cleansing process depends in large measure the after-history of the case.

I wish to emphasize the importance of taking all these cases to the operating theatre soon after their arrival. A much better examination can there be made than in a ward, and fractures are not so likely to be overlooked. I may mention one result of not following this practice. A soldier was admitted with a gunshot wound behind the left mastoid; the bullet had escaped through the concha. There were no cerebral symptoms. The wound soon healed. The day before he was to leave for England he complained of violent pain in the head, the temperature rose, unconsciousness supervened, and in less than thirty hours he was dead of general suppurative meningitis. If he had been brought to the theatre on admission, the bullet track exposed, and provision made for free, unhindered external drainage, I believe this soldier would not have suffered this fatal illness.

The use of the *probe* for the examination of the wound in order to discover a fracture of the skull or an opening in the dura mater should be forbidden, as should also the use of sutures for the closing of infected wounds of the scalp. The use of probes and sutures in hospital ships for the examination and treatment of gunshot fractures of the skull is attended with no benefit and generally with disaster. The *probe* is liable to carry inwards to the meninges or brain tissue streptococci or staphylococci which will be the source of possibly a lethal inflammation which the surgeon is powerless to arrest; and *sutures* employed to close a flap over an infected area are, as we all know, contrary to the most elementary surgical principles.

When the wound or wounds and the rest of the scalp have been thoroughly cleansed, it is almost always found that the wound or wounds are inadequate for the inspection and examination of the parts beneath. Not only does the compound fracture require exposure, but we want to know if the dura has been injured, and if it has; what damage to brain is obvious and visible. A case without injury to the dura, even though a lake of pus is outside this membrane, is likely to make a good recovery.

How should the wound in the scalp be enlarged? Shall we extend it by crucial incision or by making a U-shaped flap with the base downwards. No one should dream of making a U-shaped flap in the case of a compound fracture of the femur or tibia. Why do

so in the case of a foul compound fracture of the skull? The **U**-shaped flap was designed for use in aseptic operations on the brain. It does not lend itself for the provision of free unhindered drainage unless a large opening is made in its centre. The use of the **U**-shaped flap is thought to be an aid in the free exposure of the skull. This is a fallacy, for the making of incisions in various directions from the site of the scalp wound allows of ample exposure of the damaged area of the skull and provides better drainage.

Loose fragments of skull and depressed portions should be removed as gently as possible. The greatest care should be taken not to injure the sides of the opening in the dura mater where *protective adhesions have formed*, preventing the occurrence of general suppurative meningitis. In small punctured fractures of the skull it is desirable to trephine away from the site of the fracture and to remove the bone around the fracture with the utmost gentleness, as portions of the broken skull or inner table may be sticking in the dura, or may have been driven through that membrane into the brain substance. These must be removed with the greatest care and gentleness. *The dressings are now applied.* For foul wounds moist dressings are the best. When I was a dresser foul suppurating wounds were treated with warm chlorinated soda compresses. Now eusol dressings are often applied, but as long as the dressings are changed frequently and the wound irrigated it does not matter much what solution is chosen. Hypotonic saline, solution of iodoform in ether, malachite green, and some other lotions I have found very effective. I think a change from one dressing to another is often very useful. Some surgeons like to use a powder such as borsal (a mixture of boracic and salicylic acids), but powders generally appear to block up freely discharging wounds, as do also those substances which coagulate the plasma. We want to encourage discharge, not dam it back. It is the septic material which *passes into the man which defiles him*, not that which escapes from him.

When a considerable area of brain is exposed it is well to use some form of protective material so as to prevent the dressings sticking to it. The blue protective or gutta-percha tissue does very well for this purpose.

Hæmorrhage is not a striking feature of these cases as we see them in Malta. If the bone is injured over the superior longitudinal sinus or the lateral sinus the removal of splinters may lead to hæmorrhage. If the intradural space is not open a ligature

should not be applied around a sinus, as by so doing that space is opened; the hæmorrhage should be arrested by plugging the sinus with a strip of ribbon gauze.

During the progress of the operation above described thirty cubic centimetres of antistreptococcus serum should be injected subcutaneously and cultures from the pus should be taken, so that an autogenous vaccine may be available as soon as possible. Small scalp wounds may be excised, but in doing this we must not expect that our new cut surfaces will remain clean and uninfected.

The search for bullets or metal fragments lodged within the cranial cavity is highly dangerous, and there is seldom any réason to do so. Many instances could be mentioned of the lodgment of a bullet which apparently was innocuous after the primary damage which it inflicted. For example, a bullet passed from the right temporo-occipital region across both hemispheres and lodged in the opposite occipital region. The soldier was blind from damage to the optic radiations. An abscess formed in the right hemisphere along the track of the bullet, but nothing of the kind happened on the left side where the bullet was lodged. The soldier went to England with the wound healed and with some recovery of sight in the right eye.

In another case, that of an officer with a large left parieto-occipital abscess and some metal fragments in the abscess wall, I slightly dilated the opening and put in a larger drainage-tube. This was followed three days later by a streptococcic cerebritis and hernia cerebri—not a general meningitis—but it caused death in ten days, which illustrates the tremendous danger in all these cases of tampering with the protective adhesions around the opening in the dura.

Decompression may be required in certain cases of gunshot wounds of the head. Decompression is not a new operation, for the evidence of ancient skulls shows that trephining was practised in prehistoric times. Professor Zammit tells me that no skulls showing evidence of trephining have been found in Malta. The late Professor Lucas Championnière, in a work published in 1912, gives an account of the skulls bearing on the question which were collected in Peru and in certain parts of France, and many belong to the Stone Age, of which many monuments exist in Malta. Many of the skulls show clear evidence of survival. The operation is still practised among the Kabyles, the Montenegrins, and perhaps other peoples as it was done in the Neolithic Age. Lucas Championnière maintains that decompressive craniectomy was done

by our most remote ancestors as a therapeutic measure. Decompression in the cases which are under review to-day may be required in the earliest stage in consequence of contusion and increasing œdema of the brain. It is rarely required in gunshot injuries in consequence of hæmorrhage within the skull. Later, in consequence of infection there is increased intracranial tension from encephalitis, meningitis and hernia cerebri.

There are two ways of performing decompression in these cases: first by *lumbar puncture,* which is very effective in meningitis serosa. An officer was admitted some months ago with an extensive gunshot wound of the left temporo-parietal region which had been skilfully operated upon. At the time of admission he was unconscious and the subject of frequent fits. The same evening he had lumbar puncture performed. No further fits occurred, and he left for England a few weeks later suffering only from partial aphasia. Many instances of the value of this method of decompression could be mentioned. It never does harm, and in some cases has done inestimable good. The other method of decompression is by doing the operation of *craniectomy.* It must be remembered that removal of bone alone is useless—the dura mater is a dense, inelastic white fibrous membrane, and must be incised as well as the skull. The danger of interference with the opening caused by a gunshot wound of the dura has been already referred to, and this has led to the proposal to perform contralateral decompression, but I have not seen a case in which such a measure appeared justifiable. Decompression is most effective over the site of the injury, though it is quite true that the acute symptoms arise not from local but from general pressure. Decompression arrests all the dangers of general pressure, and, when performed over the site of injury, those due to local causes. One way of avoiding interference with the meningeal adhesions at the site of the wound in the dura which I have practised is to make a large opening in the bone and then, after placing a pad over the opening in the dura, to divide this membrane near the cut edge of the bone. Along the line of division of the dura, a strip of gauze may be placed soaked in compound tincture of benzoin or Whitehead's varnish, so as to close the subdural space till adhesions have formed.

Meningitis is the bugbear of the surgeon in the early stages of compound fracture of the skull. Brain abscess is a later complication. I have known a brain abscess form twenty years after the occurrence of a compound fracture of the skull. When pus collects in the subdural space *a pond of fluid* will form, for this space is

not divided into compartments; but when pus reaches the subarachnoid space of the cortex, this tissue being traversed under normal circumstances by countless rivulets of cerebrospinal fluid (like *marshy ground*), it become œdematous and swollen. These streams of fluid explain the rapidity with which the subarachnoid space becomes infected in subarachnoid meningitis and the rapid onset of fatal symptoms. The means employed for checking meningitis suppurativa are at present seldom successful, but successful cases have been recorded in which the local site of infection has been drained, in which bilateral posterior openings in the skull have been made and others in which frequent lumbar puncture has been practised. Irrigation from the lateral ventricle and out through a lumbar puncture cannula has not yet been successful.

"But we are no longer justified in regarding such cases as hopelessly lost and in remaining with folded hands; the rather must we attempt to save them by doing the utmost within our power."

The formation of abscess within the cerebral substance is in most cases due to a slowly spreading infection when the disease has become chronic, and adhesions have obliterated the subdural and subarachnoid cavities binding together dura, arachnoid, pia and cortex.

The lymphatic sheaths of the numerous small blood-vessels which traverse the cortex at right angles to its surface are in direct communication with the subarachnoid space and through these, as through a number of capillary tubes, infective matter easily traverses the cortex and reaches the white substance within.

The cortex is very vascular and its tissue element, reinforced by numerous prolongations from the pia mater, is abundantly supplied by connective tissue cells. Hence it is able to offer a strenuous resistance to the bacterial attack and does not, ordinarily, undergo any extensive destruction. Where it is traversed by the infective material a barrier of fibrous tissue is thrown out, limiting the destructive process to the formation of a more or less narrow track. The white substance is much less resistant, and it would seem that the greater the distance from the cortex the more easily does bacterial action cause dissolution of brain substance. Thus the abscess often assumes a mushroom-like shape with the narrow portion or stem attached to the dura at the original site of infection.

In these cases, if the abscess is not drained, there is danger of rupture into the ventricle or into the subarachnoid space, and subsequent fatal meningitis. The abscess should be opened by

a sharp pointed long and narrow knife passed through the stalk, so as to avoid the danger of meningitis. Our brains are not like Satan's :—

"Entrails, heart and head, liver or reins,"

which Milton tells us could—

"Not in their liquid texture mortal wound
Receive, no more than can the fluid air."

And a wound made by the surgeon's knife will not heal quite so readily as that inflicted by the sword of Michael, yet in the brain, as elsewhere, clean-cut wounds heal more readily than any others.

Dupuytren, in one of his lectures, in relating a case of abscess of the brain following a compound fracture, says simply : "I incised the dura mater—nothing came out ; I thrust a bistoury cautiously into the brain and there welled up immediately a flood of pus. That very night all the symptoms disappeared and the patient recovered." We cannot do better than follow in our cases the practice of Dupuytren in this historical case.

The best method of effecting drainage of brain abscess or septic softening of the brain tissue is one difficult to answer. As pus is evacuated, the fluid brain tissue flows around the tube and blocks the openings in it. There is only one piece of advice I can give you: if you get a drainage-tube of silver, glass, rubber, or other material well into the cavity of a brain abscess, do not take it out on the third day to see how it is getting on, but keep it in situ till the patient is cured.

There is one other subject about which a few words must be said, namely, the treatment of hernia cerebri. Hernia cerebri is evidence of microbic infection—it is evidence of sepsis. The part of the tumour outside the skull is generally much larger than the opening through which it has fungated. The cure of the hernia depends on the success of the measures taken to cure the sepsis. There is something in these gunshot injuries in the brain just below the hernia which is its real cause. It may be a local abscess, it may be septic softening of the cerebral substance, or it may be a piece of bone or metal. The sepsis must be treated by every measure at command and the condition of the brain beneath the hernia investigated by X-rays, etc. It is idle to apply absolute alcohol or pressure to the surface. It is dangerous to slice off a hernia cerebri. I have known death follow this procedure from infective meningitis, and if the patient were to recover the removal of cortical tissues would add to the subsequent disablement. When

a hernia cerebri becomes chronic, and the patient's condition has much improved, and if this tumour still persists, then the enlargement of the hole in the skull and dura will within a few days cause the disappearance of the tumour.

Lastly, before undertaking an operation on one of these cases, let us have a clear idea of the object to be gained. The main things always to keep in mind are:—

(1) The cleansing of the wound and surrounding scalp.

(2) The removal of foreign particles and pieces of bone which will necrose.

(3) The enlargement, when necessary, of the cranial opening without interfering with the opening in the dura.

(4) The provision of free drainage.

(5) Intravenous antiseptics are sometimes of use. I have employed (i) perchloride of mercury, 10 cubic centimetres of a 1 in 1,000 solution; (ii) eusol solution, 100 to 200 cubic centimetres in salt solution; and (iii) di-iodo-salicylic acid, 5 cubic centimetres.

(6) Do not forget to employ vaccines and antisera.

These vaccines and antisera are supposed to be modern remedies—perhaps they are.

Paulus Ægineta, a great surgeon of the seventh century, recommended that a man bitten by a mad dog should be made to eat the liver of the dog that bit him. Paulus makes the remarkable statement "that a diet of the liver of the mad dog extinguishes the power of the poison in the body of the bitten individual, and at the same time prevents it being carried deeper into the system." I wonder whether this suggestion of Paulus of Ægina is the first instance in history of the treatment of disease by the method which is now known by the title of animal organotherapy?

Paracelsus, who lived about 1500, held that Nature was sufficient for the cure of most diseases; art had only to interfere when the *internal physician, the man himself,* was tired and incapable. Then some remedy had to be introduced which should be antagonistic, not to the disease in a *physical* sense, but to the *spiritual* seed of the disease. The modern treatment by vaccines and antisera are remedies fulfilling in some degree the ideal of Paracelsus.

PENETRATING WOUNDS OF THE ABDOMEN.

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AND
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(*Report to the Medical Research Committee.*)

WE have lately had an opportunity of observing the operative results of a number of cases of penetrating wounds of the abdomen. So much debate has centred around the treatment of these cases that we believe it may be of interest to record some of the observations which we have made.

PENETRATING ABDOMINAL WOUNDS CONSIDERED LOCALLY.

WOUNDS OF THE STOMACH.

We have had a total number of six cases, and they illustrate wounds of almost every possible portion of the stomach.

Morbid Anatomy.—The degree of damage which is sustained depends on two factors—the nature of the projectile, whether shell fragment, bullet, or bomb, and the part of the stomach which is injured. In regard to the first qualification, shell fragments produce, almost invariably, the most extensive destruction, for combined with the irregularity in their shape there is a high degree of velocity in the speed with which they strike the part. These facts are illustrated both by text and diagram in Case 5. Bullets generally behave as they do in other soft tissues, that is, with a small entrance wound and a larger wound of exit; but, as will be shown later, the amount of damage produced by a bullet is very closely related to that part of the viscus which is struck, e.g., bullet wounds of the pylorus are more extensive than bullet wounds of the body of the stomach. Bomb wounds in their degree occupy a position which is midway between the shell and the bullet wound; the bomb fragment has the irregularity of the shell fragment, but its velocity is comparatively small. The region of the stomach which is injured is all important, and these remarks apply to bullet wounds, as shell and bomb wounds do not appear to be so much influenced by position. Bullet wounds in the centre of the body of the stomach have a comparatively small entrance and a slightly larger exit wound. A bullet wound in

the region of the pylorus has a relatively small entrance wound, but the exit wound is usually large and pouting; the greater degree of severity would appear to depend on the fact that the projectile passes through the thicker musculature in the neighbourhood of the pylorus (*see* Case 6).

Bullet wounds involving the greater or lesser curvature are always extensive; the lines of force are such that accompanying the actual wound there is extensive splitting and tearing of the vasculature of the stomach wall (*see* Case 5). The hæmorrhage is not severe unless the wound has actually involved one of the larger vessels (coronary or gastro-epiploic), and in this respect stomach wounds differ from wounds of the small intestine. There is usually hæmorrhagic infiltration of the peritoneal and muscular coats, and it is important to notice that there are points of tissue separation and actual tissue necrosis for a considerable distance around the wound.

Clinical Features.—Wounds of the stomach demonstrate the clinical features which one associates with wounds of the hollow viscera of the abdomen generally; there is pain, sickness, collapse, rigidity of the abdominal wall, with tenderness on pressure; but in addition to these general features there are certain distinctive signs. Sickness is usually more pronounced than in wounds of the other abdominal viscera, and in the vomited matter it is rarely that one fails to find the presence of blood. The degree of collapse is less marked than that found in intestinal injuries, but whether or not this is related to the comparatively small amount of hæmorrhage one cannot say.

It is interesting to note that while the pulse and respiration rates are both increased, the respiration-rate has proportionately increased more rapidly than the pulse-rate. The degree and the variety of the clinical features are influenced considerably by the situation of the lesion. Pain would appear to be more intense when the cardiac or pyloric ends of the stomach are involved; it is correspondingly less so when the wound is related to the body of the stomach.

Wounds of the curvatures of the stomach, with the greater destruction which invariably accompanies them, are associated with severe symptoms of collapse. The clinical features are also influenced by the condition of the stomach at the time of injury; if the stomach contains a quantity of food the wound is followed by more intense clinical features than if the organ had been empty.

Treatment.—These remarks are, of course, confined to operative treatment. If by examination we are confident that the

stomach is injured, we have found it advisable to employ a left rectal incision, either splitting or retracting the muscle; this incision gives good approach to any part of the organ, occasionally it is necessary to enlarge it laterally. When the situation of the wound is doubtful we have used an incision parallel to the left costal margin. After exposure an examination is made of the anterior surface and lesser curvature of the stomach, and of the region of the cardiac orifice. The anterior layer of the great omentum is torn through and the greater curvature and the posterior surfaces are thoroughly passed in review. We have met with conditions which called for three different lines of treatment, either singly or combined, the different lines of treatment being: (1) simple suture (Cases 1 and 2); (2) gastro-enterostomy (Case 5); (3) pylorectomy or resection of a portion of the stomach, usually combined with a gastro-enterostomy (Case 6).

In regard to simple suturing some situations are infinitely more difficult of access than others; for example, in a wound at the cardiac end of the stomach and near the lesser curvature we have experienced extreme difficulty in closing the opening. It has been our principle to excise the wound edges, thus preparing a more suitable surface for suturing and healing, afterwards closing the wound with a primary approximating and a secondary invaginating linen thread suture. Gastro-enterostomy is indicated when there is an extensive wound of the dependent part of the greater curvature of the stomach; the anastomosis may be done on the principle introduced by Kocher, but more usually the position and type of anastomosis will have to be modified by the existing conditions. Wounds of the pyloric end of the stomach are often so extensive that it is necessary to remove the damaged portion of the stomach with closure of the open ends and a secondary gastro-enterostomy.

If the peritoneal surface has been grossly soiled with stomach contents we have washed out the cavity, draining it suprapubically with a Keith's drainage-tube. In perforation of the posterior wall of the stomach, with infection of the cavity of the lesser sac of the peritoneum, we practise drainage of this space by a tube passed posteriorly above the pancreas.

Synopsis of Cases.

Case 1.—Pte. B. H., West Riding Regiment. Wounded by a rifle bullet at 10.30 a.m., he was admitted to hospital at 2 p.m. and was operated on within four hours of receiving the wound. The entrance and exit wounds were in the left epigastrium and left

loin. There was pain and sickness, the vomited matter being blood-stained, and there was the usual accompanying abdominal rigidity. The general condition was good and there was no marked collapse. The abdomen was opened in the left rectus line; perforations were found through the anterior and posterior walls of the body of the stomach; in addition the jejunum was perforated just beyond the duodeno-jejunal flexure. The perforations were closed with sutures and the usual drainage was established. The patient made an uninterrupted recovery and was discharged to the base.

Case 2.—Pte. A. F. H., Royal Engineers. This man was wounded by a rifle bullet at 6.30 p.m. on the night of August 28, 1915, and admitted to hospital at 11 a.m. August 29. The entrance and exit wounds were in the left epigastrium and left loin; great abdominal pain was complained of and the patient was practically pulseless. The abdominal cavity contained a quantity of blood and there was an effusion of blood into the left pleural cavity. So complete was the collapse that operation was delayed for three hours, and during that period various restorative measures were carried out. When operation was performed, access was gained to the abdominal cavity by an incision parallel to the left costal margin. The abdominal cavity was full of blood, there was a wound of the stomach where the lesser curvature joins the œsophagus and from it stomach contents were escaping; the profuse hæmorrhage had apparently originated from a branch of the coronary artery. With great difficulty the perforation was sutured; the peritoneal cavity was washed out and drainage secured. The patient died about two hours after the completion of the operation. Post-mortem examination showed that in addition to the wound of the stomach the lower lobe of the left lung was perforated, while the pleural cavity contained a large quantity of blood.

Case 3.—Pte. B. W., King's Royal Rifles. Wounded at 7 p.m., September 11, he was admitted to hospital at 10 p.m. of the same date. There were entrance and exit wounds in the left back and loin. There were the usual signs of injury to the abdominal viscera; there was a considerable degree of collapse, the pulse-rate on admission being 130. The abdomen was opened by an incision running parallel to the left costal margin. It was found that the projectile had grazed the left end of the greater curvature of the stomach; in addition there was a perforation of the splenic flexure of the colon. The perforations were closed with sutures and drainage established. On the sixth day a fæcal fistula developed from the colon wound, but otherwise a good recovery was made.

Case 4.—Pte. H. W., Rifle Brigade. Wounded at 10 p.m., August 29, 1915, he was admitted to hospital at 2.30 a.m. of the following day. On admission it was found that the collapse was so intense that any operative procedure was entirely out of the question; he died a few hours after admission. Post-mortem examination showed that there was a large tear in the greater

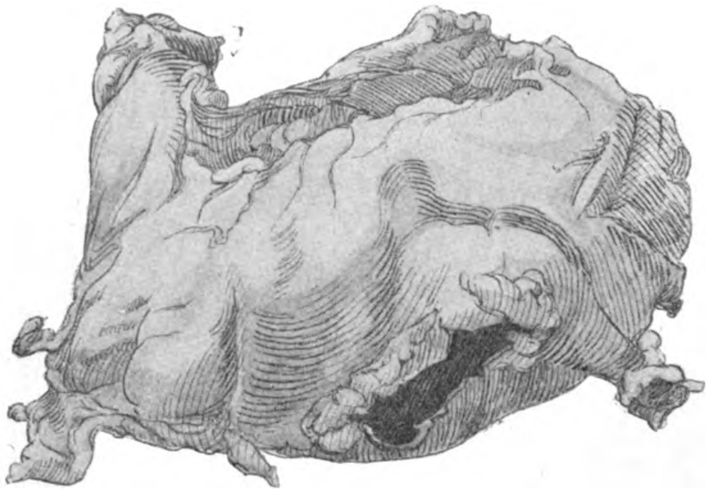

Fig. 1 (to illustrate Case 4).—Bullet wounds of the greater curvature of the stomach.

curvature of the stomach; in addition the bullet had passed through the left lung, and the pleural cavity contained a quantity of blood. This case was not operated on, but we have included it to show the greater degree of severity and collapse which follows wounds of the greater curvature of the stomach. This patient was admitted about four hours after sustaining his wound, but even at that early period he was entirely beyond operative aid.

Case 5.—Pte. G. H., York and Lancs. There was a shell wound of the left hypochondriac region sustained at 8 a.m. of September 23, 1915; he was admitted to hospital at 4.30 p.m. of the same day. There were all the signs of injury to the abdominal viscera and in addition it was obvious that the patient was bleeding profusely internally. The abdomen was opened through the left rectus; it contained a large amount of free blood mixed with gas. Along the greater curvature of the stomach there was a wound about two and a half inches long; the position of the wound was

such that it permitted of a gastro-enterostomy being done between the open wound and the jejunum. The edges of the stomach wound were excised. In addition to the stomach wound there were seven perforations in a two and a half feet length of small intestine, necessitating resection and lateral anastomosis. The patient survived the operation for about eight hours and then died of collapse. The case demonstrates the suitability of a gastro-enterostomy under certain conditions.

Fig. 2.

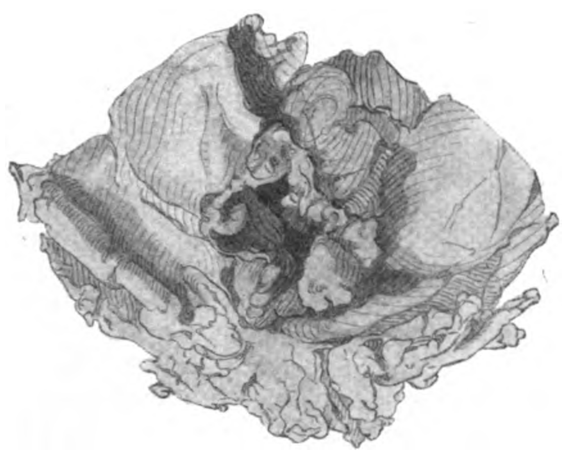

Fig. 3.

FIGS. 2 and 3 (to illustrate Case 6). Fig. 2, anterior view of the pylorus, showing the small entrance wound. Fig. 3, posterior view of the pylorus, showing the large exit wound.

Case 6.—Cpl. A. C., King's Royal Rifles. This man was wounded at 6 p.m., September 24, 1915, and he was admitted to hospital at 1.30 a.m. of the following day. On admission there were

all the signs of injury to the abdominal viscera, but the collapse was too great to permit of immediate operation; operation was therefore delayed for two hours. Upon opening the abdomen it was found to contain a large quantity of blood, there was a perforation through the antrum pylori with a small entrance, and a large blown-out exit wound; in addition there were five perforations in the upper end of the jejunum. The damaged portion of stomach, the pylorus and a portion of the body of the stomach were removed, the open ends were closed, the damaged loop of intestine was resected, an anastomosis done, and a gastro-enterostomy performed between the body of the stomach and a loop of jejunum. This patient lived for twenty-four hours; during that period his pulse remained good and there was no sickness; he died eventually with extreme suddenness. This case illustrates the occasional necessity of removing a portion of the stomach.

RESULTS OF STOMACH CASES.

Total	Bullet wounds	Shell wounds	Suture	Gastro-entero-stomy	Resec-tion	Compli-cated with injured gut, etc.	Lived	Died	Unope-rated on
6	5	1	3	1	1	6	2	3	1

WOUNDS OF THE SMALL INTESTINE.

Under this heading we have a total of twenty-one cases to consider.

Morbid Anatomy.

Among the series we have had cases of bomb, bullet and shell wounds, and each of these varieties has distinctive features. Bomb fragments produce small and multiple wounds with slight evagination of the edges, but with a marked tendency to surrounding ecchymoses and hæmorrhage (Cases 11 and 23).

Bullet wounds, when caused by a projectile travelling at a great velocity and fired at a comparatively short range, are small perforations, with slightly larger exit than entrance wounds (Case 22). Bullets travelling at a lower velocity result in considerable destruction of the gut wall. When the projectile passes across the long axis of the gut it may pierce it through and through, but sometimes it tears it open as though it had been cut by a knife (Case 24). Bullets passing obliquely through or in the long axis of the gut produce extensive injuries; if in the long axis of the gut,

the bowel is torn completely open (Case 13); if the intestine has been struck obliquely, there are two large perforations, one on each side with an intervening bridge of tissue (Case 14).

The damage produced by shell fragments is usually very extensive (Case 12), but if the force of the fragment is nearly spent our experience has been that the wound is no larger than the fragment which caused it—in one instance we have found the fragment of shell embedded in the gut wall (Case 18).

As regards position, wounds of the free edge of the gut are more extensive than those which occur at the mesenteric border. Correspondingly, wounds of fixed parts of the small intestine, e.g., duodeno-jejunal flexure and the ileo-cæcal junction, are less extensive than wounds of the freer portions of the gut.

Hæmorrhage from the small intestine is as a rule severe; especially when the wound has occurred in the jejunum. It is remarkable how rarely there is a massive escape of contents from the lumen of the gut—we have never seen it occur to any marked degree; apparently there is a complete inhibition of peristalsis for some time subsequent to the injury. Further, the less the damage to the gut and the fewer the number of perforations, the more likelihood is there of extensive peritoneal soiling. We believe the converse holds good.

When the gut is injured it is rarely that the mesentery escapes, nd one is exceedingly apt to overlook a wound in this region. When a large mesenteric vessel is cut the hæmorrhage is rapidly fatal—but even in division of a comparatively small vessel or series of vessels the hæmorrhage is progressive, a characteristic which is curiously peculiar to intra-abdominal bleeding. When the blood-vessels in the mesentery are damaged, one is faced with the question whether the viability of the associated gut is or is not interfered with. In this relation we have observed that while interference with the mesenteric blood may not actually endanger the viability of the gut, that portion of gut is particularly liable to a subsequent distension which may pass on to an actual paralysis.

There is nothing characteristic about the superficial wound. Unless one is prepared for it, one is at first apt to overlook the fact that bullet wounds of the buttock are liable to be followed by evidences of injury to the abdominal viscera.

Clinical Features.—The clinical features are those of commencing peritonitis coupled with the evidences of a rapid and progressive hæmorrhage. The facial expression is one of intense distress, pallor may become evident and deepen. The pulse

becomes progressively and rapidly quicker and weaker. General abdominal pain is complained of, the pain being accentuated at intervals. There is frequently retention of urine. Sickness comes on, and during the attacks of vomiting the abdominal pain is intensified. The temperature at first falls, and after some hours begins to rise. As a rule, there is fixation of the abdominal wall, and the respirations are largely thoracic in type. Palpation elicits general tenderness, and palpation confirms the muscular rigidity which exists. Under the influence of morphia, and sometimes when the intra-abdominal bleeding is profuse, we have seen the muscular rigidity of the abdominal wall almost disappear. By percussion it is frequently possible to demonstrate the presence of dulness in the flanks and the diminution of liver dulness.

In later and untreated cases the clinical features are those of acute general peritonitis.

Treatment.—Later there are described measures which we have carried out preliminary to all abdominal operations for this class of case, measures which are intended to antagonize the shock and loss of blood which occur. As a preliminary to operating for perforating wounds of the small intestines, these precautionary methods are of the highest practical importance, as the amount of shock and the loss of blood in these cases are often exceptionally severe.

To open the abdominal cavity we have almost invariably used a middle-line incision—it is important that there should be no hesitation in making the incision one of considerable length. In localizing the sites of injury we have followed a well-defined routine. After opening the abdomen, the cæcum is identified, and from it the small intestine is traced upwards, beginning with the lower end of the ileum. As each perforation of the gut is exposed, it is wrapped up in a small moist swab; to one side of the swab a length of tape is stitched; this is slipped through the mesentery, and doubled twice round the gut covered by the swab; in this way each perforation is marked, and at the same time there is less chance of a massive infection from the injured part. The whole length of the small intestine must be examined before any decision as to treatment is arrived at—there is nothing more disconcerting than to deal with a perforation by resection and to find that a few inches farther on there is another perforation which could have been included in the same procedure. When the degree of damage to the gut has been brought under review, there are three varieties of operative treatment which may be followed; these are:

(1) Simple suture of the perforations; (2) resection of the damaged intestine followed by a lateral or end-to-end anastomosis; (3) resection of the damaged intestine with an accompaniment of a temporary enterostomy.

(1) *Simple Suture of the Perforations.*

In the series of cases which came under our notice a small minority proved suitable to be dealt with by simple suture. In order to be suitable it is essential that the wound is small, without damaged edges and with an intact mesentery. Bomb fragments cause wounds which are most ideally suitable for suture.

The method has the obvious advantages of speed and simplicity of technique. There are certain distinct disadvantages. The suture may result in considerable narrowing of the gut lumen, and when there are a number of similar sutures within a short distance of each other the multiple narrowing becomes a very real objection. The second objection is that a suture, unless very complete, is apt to be followed by a local sloughing of the part. The edges of the perforation are devitalized and the microscope has shown that actual necrotic changes can be distinguished in the tissues for some distance around the wound.

In the suture operations which we have done we have not excised the wound edges, and we have used linen thread as the medium for stitching (Cases 7, 8, 9, 10, and 11).

(2) *Resection of the Damaged Intestine followed by Lateral or End-to-end Anastomosis.*

There are certain indications which necessitate this method of treatment: multiplicity of the perforation, extent of the degree of the perforation and involvement of the related mesentery. We have distinctly favoured this method of treatment, and we have preferred it at times when another method might have been chosen. Two disadvantages have been quoted: the complexity of the technique and the time which the operation entails. In regard to the second objection we question if it takes any longer to complete a resection and anastomosis of gut than to do a multiple suture operation. The advantages are very great; the operation is a complete and a thorough one, the risk of damage following a mesenteric involvement is minimized; there are not the possibilities of local areas of sloughing as are so apt to occur in suture operations, and there is less possibility of subsequent stricture. Having

weighed the choice of the operation the question next arises whether the anastomosis is to be a lateral or an end-to-end one. When we began this work we favoured and used an end-to-end anastomosis, on the ground that it could be accomplished in a shorter period of time than the lateral anastomosis. We discovered that this method was apt to be followed by a certain degree of paresis in the proximal segment with subsequent distension and eventual obstruction. On one occasion we had to perform a second short-circuiting operation to overcome the obstruction (Case 13).

The gut appears to be predisposed to the distension from various causes: the general degree of nerve shock and more especially of sympathetic nerve shock, the paresis of Auerbach's plexus as a result of the blow, the presence of blood in the peritoneal cavity, and the degree of peritonitis which invariably is present. As a result of this disadvantage we began to employ a lateral anastomosis and from it we have had undoubtedly greater satisfaction and better results. In point of time, the lateral anastomosis takes a few moments longer in so far as it involves closing the open ends of the gut, but it apparently largely overcomes the possibility of distension of the proximal segment. We do not intend to enter into any details of the operation beyond mentioning that when the resected gut involves the extreme lower end of the ileum we have anastomosed the proximal bowel to the centre of the transverse colon. Short-circuiting, so to speak, by a unilateral short circuit the caecum, ascending colon and hepatic flexure, there are obvious mechanical advantages related to this method (Case 14).

(3) *Resection of the Damaged Intestine with the Accompaniment of a Temporary Enterostomy.*

Fortunately we have only had occasion to have recourse to this most unsatisfactory procedure in one instance (Case 25). It is justified when rapidly developing collapse necessitates that the operation be finished as quickly as possible: the damaged bowel is cut away and the open ends are sutured to the skin wound.

When there is gross soiling of the peritoneal cavity we have washed out the abdominal cavity with hot saline solution, draining subsequently suprapubically with a glass Keith's tube.

Synopsis of Illustrative Cases.

Case 7.—Pte. B. T., Middlesex. There was an entrance wound in the left umbilical region; there was no exit wound apparent. There were signs of injury to the abdominal viscera but the general

condition was good. From the wound a coil of small intestine was prolapsed. At the operation the wound was enlarged; two perforations were found in the lower end of the ileum; the perforations were closed with purse-string and inverting sutures. Beyond a subsequent slight infection of the retroperitoneal tissues which required drainage, the patient made a good recovery.

Case 8.—Pte. B. H., West Riding Regiment. Entrance and exit wounds were caused by a bullet received four hours before admission; the general condition was good. Operation revealed two perforations of the jejunum just beyond the duodeno-jejunal flexure; these were closed with purse-string and invagination sutures. This case in addition showed two perforations of the stomach. Drainage was secured. The patient made a good recovery.

Case 9.—Pte. P. H., Northumberlands. This patient was wounded on the 26th of the month, but owing to military exigencies it was the evening of the 29th before he was admitted for operation; there was then an entrance wound below the umbilicus, together with all the evidences of extensive general peritonitis. It was doubtful whether operation was advisable, but it was decided to attempt it. A single perforation was found in the lower end of the ileum; this was sutured and drainage was secured. Subsequent to the operation the patient improved considerably; he apparently was on the road to recovery, the bowels moving well, when a week after the operation he died suddenly from what apparently was heart failure.

Case 10.—Pte. T. S., East Lancs. There were entrance and exit wounds, the bullet having entered the right buttock and come out anteriorly below the umbilicus. There were the usual evidences of injury to the abdominal viscera, and the general condition was fair. Operation showed a single perforation in the upper end of the ileum; there was extensive soiling of the peritoneal cavity and a commencing general peritonitis. The perforation was closed by suture. Four days after operation the patient succumbed to the general peritonitis which was present.

Case 11.—Pte. A. H., Black Watch. This man was wounded by a bomb explosion and there were a number of entrance wounds in the left flank. There was intense shock—pulse being 150. A number of fragments had entered the abdominal cavity and there were all the signs of injury to viscera. In addition, two fragments had entered the left lung and a third entered the spinal cord, producing complete paraplegia below the eighth dorsal segment. After waiting some hours for a possible improvement operation was

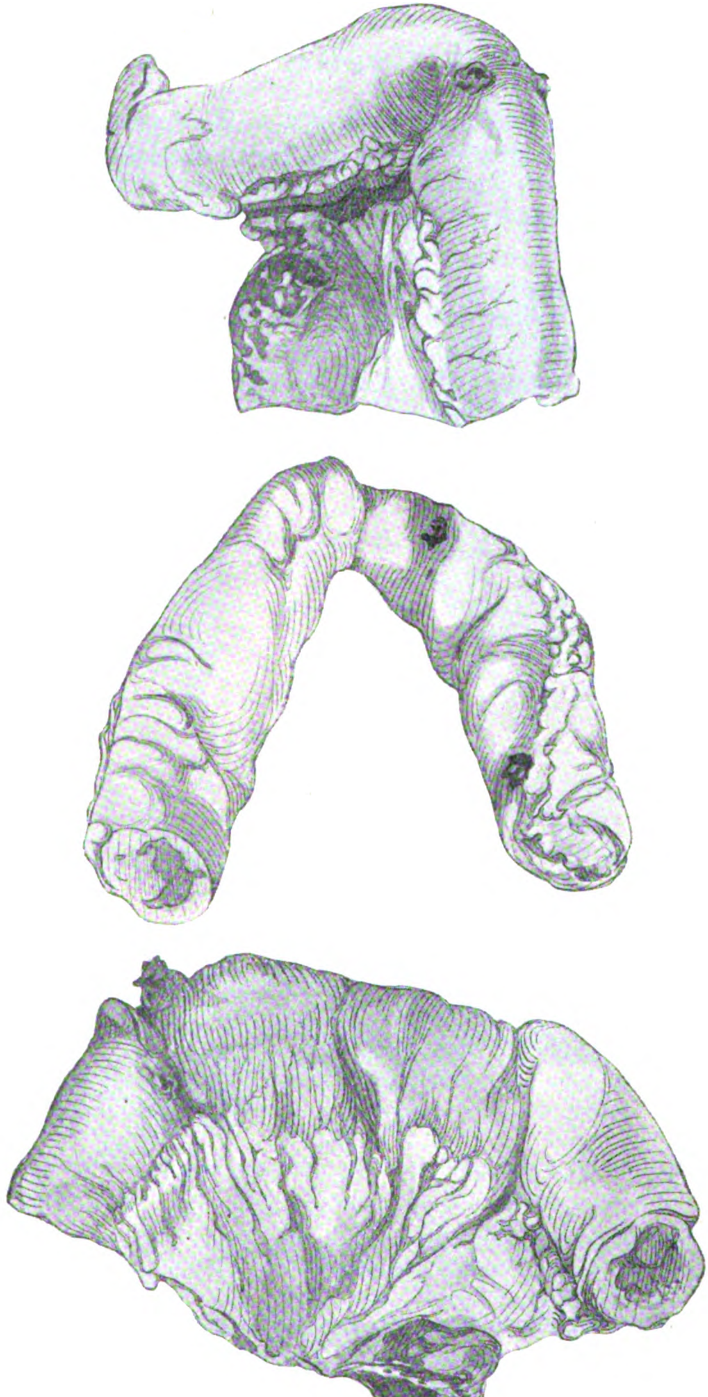

FIG. 4 (to illustrate Cases 11 and 23).—Bomb wounds of the small intestine. Note the comparatively small size of the wounds, the surrounding ecchymoses, and the suitability of such cases for suture.

carried out. The abdomen contained a large amount of blood; there were four perforations in the jejunum about eight inches below the duodeno-jejunal flexure; each was closed by suture. In addition the transverse colon was perforated at its centre, in the

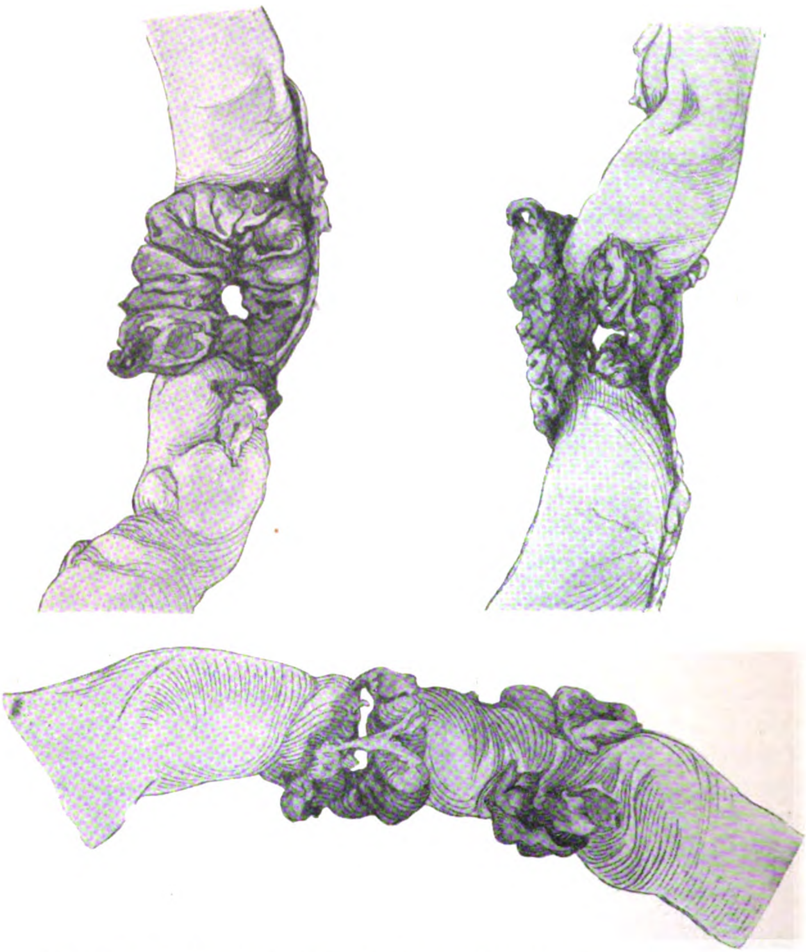

FIG. 5 (to illustrate Case 12).—Wounds of small intestine caused by a fragment of common shell. Note the very extensive degree of injury in each case.

descending colon there were six through-and-through perforations; these wounds were sutured. The abdomen was washed out and drained suprapubically and in the left flank. As far as the abdominal condition is concerned we believe we are justified in

looking on this case as a success; his eventual history, however, shows that he ultimately died of a gradual ascending spinal meningitis secondary to the infected wound of the spinal column.

The above cases are illustrative of the suture operation.

Case 12.—Pte. G. H., Yorks and Lancs. In this case the injuries were the result of a shell wound. There was intense collapse. The abdominal cavity was filled with blood, there were seven perforations in a two-and-a-half-foot length of small intestine (upper end of ileum); practically all of the perforations were very large wounds. Three feet of small intestine were removed and a lateral anastomosis completed. In addition the stomach was extensively torn, necessitating a gastro-enterostomy. The patient survived for eight hours and died of collapse.

Case 13.—Pte. W. G., Seaforth Highlanders. On admission the patient was collapsed, there was progressive hæmorrhage from both superficial wounds, and general abdominal rigidity. The operation was performed under spinal anæsthesia. The deep epigastric artery of the left side was severed, hence the superficial bleeding; the abdominal cavity was full of blood. In the upper

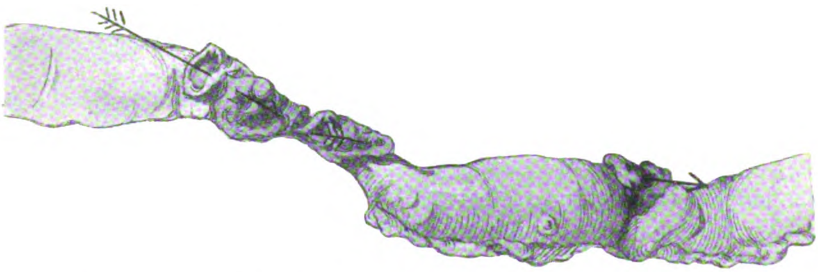

FIG. 6 (to illustrate Case 13).—Eighteen inches of gut injured by rifle bullet. A portion of the lumen of the gut is torn widely open where the bullet has passed in the long axis of the intestine. The arrows illustrate the course of the bullet.

end of the ileum there were three perforations—two small and one exceedingly large, opening up the gut for about one and a half inches. Nine inches of gut were removed and an end-to-end anastomosis completed. Forty-eight hours later signs of obstruction developed and the abdomen was again opened under spinal anæsthesia; the proximal segment of gut at the anastomosis was distended and there was a large effusion of blood into the mesentery of this portion of the gut. A lateral anastomosis was done, short-circuiting the end-to-end suture. Patient made an uninterrupted

recovery; two months later we have heard from him as being in excellent health.

Case 14.—Pte. L. T., Black Watch. This man was wounded in the right buttock and six hours after having received the wound he was admitted to hospital; there were all the signs of injury to abdominal viscera. The operation was done under spinal anæsthesia. When the abdomen was opened a perfect fountain of blood

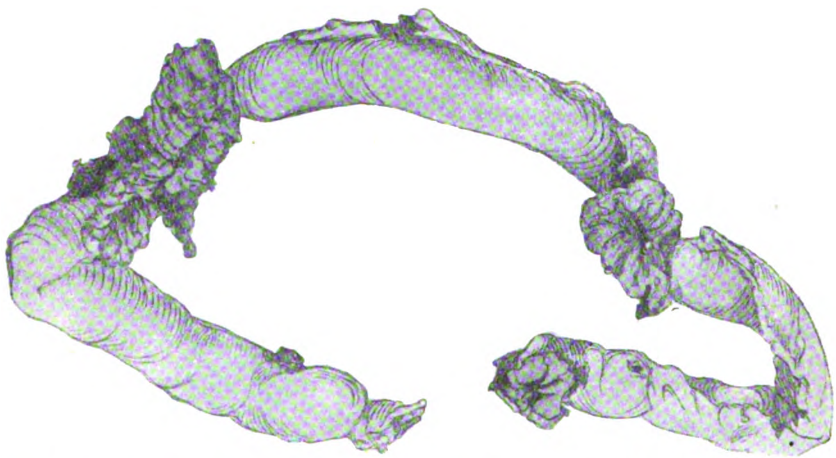

FIG. 7 (to illustrate Case 14).—Two feet of the lower ileum injured by rifle bullet. Two portions of the gut have been entirely destroyed by the projectile.

escaped; in the lower two feet of ileum there were six perforations, in two instances the gut was shattered to pieces. The damaged intestine was removed and a lateral anastomosis completed between the ileum and the centre of the transverse colon. Patient made an uninterrupted recovery and three months later he informed us that he was enjoying excellent health.

Case 15.—Cpl. A. C., King's Royal Rifles. Seven and a half hours elapsed since receipt of a bullet which had passed through the abdomen from side to side. There was intense collapse and operation was delayed for two hours. At operation there were found to be five large perforations in the upper part of the jejunum. In addition the transverse colon was torn across and the stomach was almost divided in two places. The damaged loop of small intestine was removed, and a lateral anastomosis completed; the stomach wounds were repaired and a gastro-enterostomy done, the damaged colon was brought out and a colostomy completed. The patient

stood the operation remarkably well and he survived for over twenty-four hours; during that time there was no sickness and his pulse remained good. He then suddenly collapsed and expired.

Case 16.—Pte. E. H., King's Royal Rifles. The wound had been sustained in the right loin and the bullet had taken an oblique path, being embedded below the left costal margin. Fifteen hours had elapsed since receipt of the injury and the collapse was intense. After waiting some time and taking measures to overcome the collapse, it became obvious that there would be no improvement and that the patient was bleeding rapidly internally. The abdomen was opened: eighteen inches from the duodeno-jejunal flexure the gut was torn across in three places, and there was profuse bleeding from a large branch of the mesenteric artery. The damaged gut was resected and the bleeding arrested. The patient died thirty-six hours after operation. Post-mortem examination showed no other lesion and death was due to hæmorrhage and collapse.

Case 17.—Serjt. S. P., Worcesters. The entrance and exit wounds were in opposite flanks. There was complete collapse, seventeen hours having elapsed since the receipt of injury. There were all the evidences of general peritonitis and the abdominal cavity contained a quantity of fluid. Operation was conducted under spinal anæsthesia. The peritoneal cavity was found to be full of blood. In two and a half feet of small intestine (lower end of jejunum) there were seven perforations, several of them tearing the gut entirely across. During the operation there was progressive bleeding from the retroperitoneal tissues; its source could not be found. After the operation the patient steadily sank and died ten hours later.

Case 18.—Pte. A. H., Lincolns. Shell wound. There were entrance and exit wounds in the right epigastrium and left flank: there were all the signs of injury to the abdominal viscera, but the degree of collapse was not marked. Operation revealed the abdomen to be full of blood and gas; twelve inches of jejunum were extensively damaged by six perforations; in the wall of the gut the fragment of shell was embedded. The transverse colon was torn across at its centre. The damaged small intestine was removed and a lateral anastomosis completed; the perforated transverse colon was converted into an efficient colostomy. Patient made an uninterrupted recovery.

Case 19.—Pte. H. B., Rifle Brigade. On admission this patient showed entrance and exit wounds from the right buttock to the left hypochondrium. There was profuse external hæmorrhage. The

man was practically pulseless, but he improved somewhat after the intravenous transfusion of saline. There were all the signs of a generalized peritonitis. Operation was conducted under spinal anæsthesia, but the patient succumbed before any operative procedure could be carried out. Subsequent investigation showed that there were ten wounds throughout the small intestine, nearly all of which had torn the gut entirely across. For a distance of six inches in one part the lumen of the gut was entirely destroyed. In addition, the iliac colon was divided and the internal pudic artery was severed as it lay in Alcock's canal.

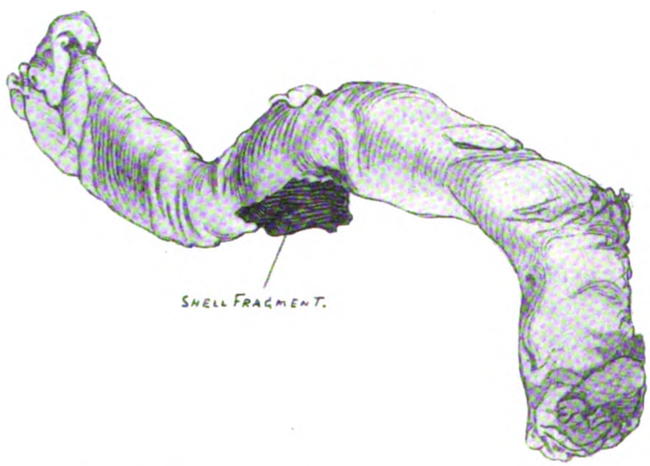

FIG. 8 (to illustrate Case 18).—A length of jejunum removed for injury by a fragment of shell. The intestine showed six perforations, and a fragment of shell was found embedded in the wall of the gut.

Case 20.—Pte. H. C., Wiltshire Regiment. The entrance and exit wounds were from side to side of the abdomen, and from the exit wound there was a considerable protrusion of omentum. On admission the general condition was good, but there were all the evidences of injury to the abdominal viscera. When the abdomen was opened the cavity was found to be filled with blood; there were seven perforations in the upper four feet of jejunum and in two instances the gut was shattered to pieces. The damaged gut was removed, and as the proximal portion was too fixed to permit of a lateral anastomosis an end-to-end suture was carried out. The patient died forty-eight hours after operation. Post-mortem examination revealed an intense peritonitis, especially in the upper part of the abdomen, and this apparently was the cause of death.

Case 21.—Cpl. B. A. E., Durham Light Infantry. There was an entrance wound in the left buttock; there were the signs of injury to the abdominal viscera, together with symptoms of intense collapse, pulse being 130. Ten hours had elapsed since the injury was received. The abdomen was opened in the middle line under spinal anæsthesia. There was an immense effusion of blood. Three feet of the ileum were found to be extensively damaged and torn with eight perforations. The damaged gut was removed and a lateral anastomosis completed. The patient succumbed a few hours after operation.

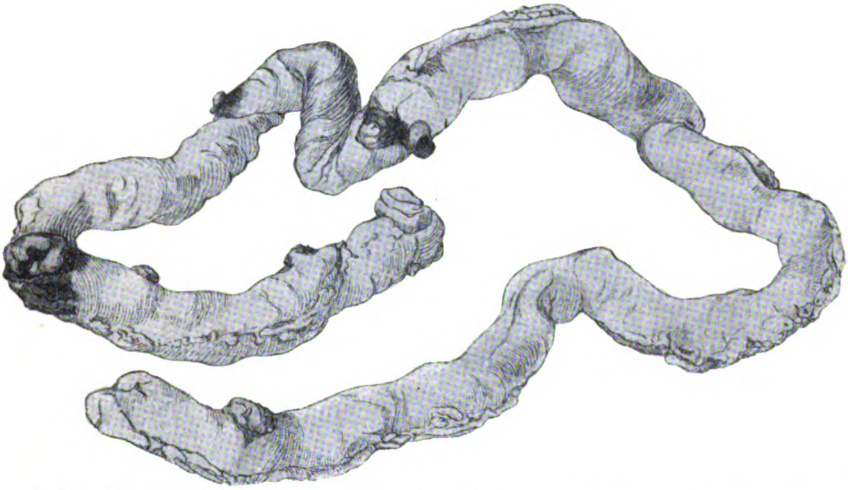

FIG. 9 (to illustrate Case 22).—Four feet of gut containing perforations from a machine-gun bullet. The bullet has passed with a high velocity through various coils of gut, passing across the long axis of the gut. The resulting damage is not extensive.

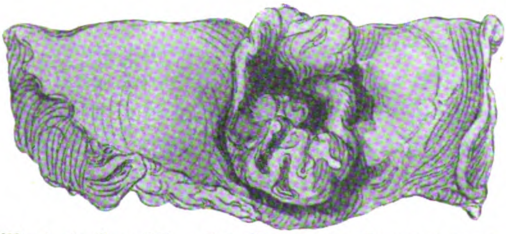

FIG. 10 (to illustrate Case 22).—This illustration demonstates the pouting appearance of the mucous membrane at the point of exit.

Case 22.—Pte. R. J. W., Irish Guards. Patient was shot at close range by a machine-gun bullet. He was operated on within two hours of receiving the injury, and his general condition

was good; there were all the signs of injury to the abdominal viscera. Operation showed that the abdominal cavity contained a large quantity of blood. There were eight perforations in the lower end of the jejunum, and it was necessary to remove four feet of intestine. This was done, and a lateral anastomosis completed. The ureter was also injured. Patient made a complete and uninterrupted recovery.

Case 23.—Pte. McJ., Black Watch. This man was wounded in a bomb explosion, and there were at least five penetrating wounds of the abdomen. When admitted he was very collapsed, pulse being 150. Operation was delayed for some time, and then performed under ether anæsthesia. There was a great amount of effused blood. Tracing the small intestine, there were fourteen perforations in the lower end of the jejunum, and it was necessary to remove six feet of gut; a lateral anastomosis was completed. There were four perforations in the descending colon, and these were closed with suture; a single large perforation in the transverse colon was converted into a colostomy. The patient passed a comfortable night and was remarkably well throughout the following day. He died somewhat suddenly on the second morning after operation.

Case 24.—Pte. C. R., Seaforth Highlanders. There was a single entrance wound in the left buttock. It was interesting to note that there was no rigidity on palpation, but pain was complained of. Collapse was so intense that immediate operation was impossible; after some hours there was a slight improvement, and operation was then performed under ether. There was an enormous quantity of free blood in the peritoneal cavity; there were four large perforations of the lower end of the ileum, three of them tearing the gut completely across, in addition there were three extensive bruises of the gut and two tears in the mesentery which were bleeding profusely. Eighteen inches of small intestine were removed. The iliac colon was so damaged that it was necessary to perform an inguinal colostomy. The patient died of shock eight hours after operation.

The above cases are illustrative of the operation of resection and anastomosis of the intestine. In discussing the treatment of perforating wounds of the intestine, we mentioned the possibility of having in some cases to do a resection of intestine with the formation of a temporary enterostomy. It is an unsatisfactory operation, and, fortunately, we have had to resort to it in only one instance. That instance we now quote.

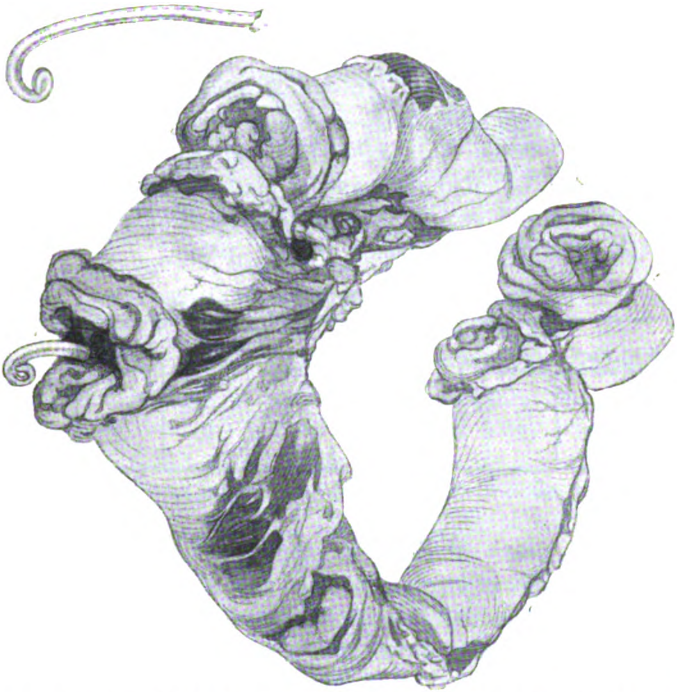

FIG. 11 (to illustrate Case 24).—The gut has been divided almost entirely across in four different places. All these injuries have been caused by a single rifle bullet. The round worm shown in situ was divided by the bullet.

Case 25.—Pte. W. J., Black Watch. There was an entrance wound below the umbilicus, and there were evidences of injury to the abdominal viscera, in addition there was extreme collapse. On opening the abdomen there were found to be four perforations in the small intestines—in addition, the rectum and the bladder were perforated. A suprapubic cystotomy and a colostomy were performed; there was no time to carry out an anastomosis of the gut, and the open ends of the intestine were stitched to the skin edges, after cutting away the damaged gut. The patient succumbed from shock a few hours after operation.

In conclusion, we quote two cases, the seriousness of whose general condition precluded any possibility of operative treatment.

Case 26.—Pte. T. H., Cheshires. There was an entrance wound in the left buttock. The collapse was so intense that death ensued about one hour after admission. Examination showed eight perforations in the lower end of the ileum, two perforations in the

lower end of the jejunum, and a complete severance of the iliac colon. There was a quantity of loose bone in the abdominal cavity.

Case 27.—Sapper H. J., Royal Engineers. This man was wounded with shrapnel, and there was a large entrance wound in the left flank. When admitted the patient was pulseless and unconscious, and he died one and a half hours after admission. Examination showed eight perforations in the lower end of the ileum, with extreme destruction of the gut.

RESULTS OF SMALL INTESTINE CASES.

Total	Bullet wounds	Shell wounds	Bomb wounds	Suture	Resection	Enterostomy	Complicated cases	Recoveries	Died	Unoperated
21	17	2	2	5	13	1	10	7*	12	2

* One case eventually succumbed to an ascending spinal meningitis.

WOUNDS OF COLON.

We have a series of twelve cases to record, but several of these have been already mentioned in dealing with stomach and small intestine injuries. The general remarks one would make are very similar to those we have already mentioned in relation to the small intestine, but there are several points which are more or less peculiar, and these will be dealt with.

Morbid Anatomy.

The effects of shell, bullet, or bomb vary exactly as they do in the small intestine. Very similarly also the damage appears to vary according to whether the colon is fixed or free; for example, the transverse colon and the free loop of the iliac colon are frequently torn entirely across, while in the more fixed points simple perforation is the rule.

Effusion from a wound of the colon has a liability to be shut off and localized, more especially when the wound occurs in the ascending or the descending colon; it is quite common to meet with a collection of fæcal and semi-purulent matter entirely shut off and opening into the underlying colon (Case 28). It is, of course, an established fact that if the infection does not become localized the peritonitis from a large intestine wound is intensely virulent.

Clinical Features. — The clinical features are very similar

to those of the small intestine injury. They are, primarily at least, not so widespread, and early sickness as a rule is absent.

Treatment.—We have drawn attention to the liability which colon wounds have of becoming localized, and this fact has a bearing on the operative treatment which one employs. The bearing is, that if the patient comes under treatment at a period longer than twenty-four hours after the receipt of the injury it is a wise principle, primarily at least, to enlarge the original wound on the possibility that the infection is becoming localized. At an earlier period than twenty-four hours it is probably better to open the abdomen through a separate incision.

We have been impressed with the risk which one runs of overlooking injuries to the colon, and in one instance we have made this mistake (Case 35). The risk is greatest when the wound lies in one or other of the flexures of the gut.

The actual operative treatment may be summarized in two methods: (1) Simple suture; (2) simple suture with colotomy. The operation of resection may be left out of account; it is rarely advisable to practise it in this type of surgery. We have favoured the use of a colotomy in combination with the operation of suture; there is the obvious advantage that it increases the safety of the suture, while it obviates the passage of fæcal matter through the damaged gut.

In wounds of the ascending and the descending colon we have been impressed with the advisability of draining the retrocolic space by a tube passing into the loin.

Case 28.—Serjt. B. A. The wound had been sustained with a fragment of shell about twenty-four hours previously; his general condition was good and local signs pointed to the fact that the injury and infection were limited to the neighbourhood of the wound. The original wound was opened up, exposing a small collection of fæcal and semi-purulent matter; the containing cavity communicated with a wound in the ascending colon. The cavity was drained and a fæcal fistula developed. Recovery.

Case 29.—Pte. B. W., King's Royal Rifles. The entrance and exit wounds were in the left loin; there were the signs of injury to the abdominal viscera, and a considerable degree of collapse. The abdomen was opened parallel to the left costal margin. There was a wound in outer side of the splenic flexure of the colon; the wound was closed with suture and drainage established in the flank. A fæcal fistula developed on the fourth day. Recovery. In this case the stomach also was injured.

Case 30.—Pte. O. H., Lincolns. This man was wounded with a fragment of shell. Opening the abdomen, in addition to wounds of the small intestine it was found that the transverse colon was divided at its centre. The transverse colon was brought out and so repaired that a single Paul's colotomy tube was fastened into the gut lumen at the site of injury; a length of small intestine was resected. Recovery.

Case 31.—Rifleman P. F., Rifle Brigade. There were entrance and exit wounds in each loin respectively with complete abdominal rigidity; the general condition was good. The abdomen was opened in the middle line; there was a large quantity of free blood in the peritoneal cavity. Two large perforations were found in the ascending colon; a local colotomy and repair was done. The bullet in its course had passed through the spinal column, but without damaging the spinal cord. He remained well until 6 a.m. of the following morning, his pulse then suddenly failed and he died an hour later. Death was apparently due to peritonitis and shock.

Case 32.—Pte. S. J., North Staffords. The injuries were the result of shell wounds; there were three entrance wounds on the outer side of the hip. The patient was practically pulseless. Operation was delayed for two hours and restorative means were applied; operation was finally carried out under spinal anæsthesia. There was a large perforation of the iliac colon immediately above the loop; at a higher level the posterior wall of the descending colon was torn. Repair and colotomy were done. Death from shock ensued twelve hours later.

Case 33.—Cpl. H. J., Royal Irish Rifles. A bullet wound had been sustained twenty-four hours previously. There was a much greater degree of collapse than seemed compatible with the injury. The entrance wound was enlarged, the iliac colon was perforated in two places, there was no evidence of injury to other viscera. Repair and colotomy were performed. Throughout the first and second days following operation the patient steadily improved; on the third morning he was exceedingly well, when suddenly about midday he developed an extensive secondary hæmorrhage. At this point the case passed out of our hands and we are unaware of his further history.[1]

Case 34.—Pte. T. H., North Lancs. There were entrance and exit wounds in opposite loins; the exit wound admitted two fingers.

[1] We have since heard that this patient died.

There were all the signs of injury to the abdominal viscera. On opening the abdominal cavity it was found to contain a large quantity of blood, there was a large wound of the postero-external surface of the hepatic flexure and there was also an extensive tuberculous peritonitis. With difficulty the wound in the colon was sutured. The patient died nine hours later. Post-mortem examination showed the presence of a generalized tuberculosis.

Case 35.—Pte. B. A., D.C.L.I. This patient was admitted suffering from a bayonet wound of the abdomen, the weapon having entered below the left costal margin. There were no evidences of abdominal infection, but the abdominal cavity was opened. No perforation was found, and there was neither free blood nor evidence of infection. The following day there was all the evidence of a general peritonitis; investigation showed that we had overlooked a small perforation below the splenic flexure. The patient later succumbed to peritonitis. This last case illustrates the liability of overlooking small wounds of the colon when they are situated in out-of-the-way places such as the hepatic and splenic flexures.

Case 36.—Pte. F. A., Worcesters. This patient was admitted suffering from a bullet wound of the left loin. Operation showed that the bullet had grazed the outer wall of the descending colon; it had not penetrated the mucous coat of the gut. The damage was repaired and local drainage was secured. On the second day after operation there was a suspicion of a fæcal fistula, but this disappeared. Patient made a complete recovery.

Case 37.—Pte. M. H. W., R. W. Fusiliers. A fragment of common shell had passed through the left iliac fossa; the pelvis was fractured, and omentum was protruding from the wound. Operation showed that about one inch of the sigmoid flexure was entirely destroyed. A colotomy was performed and drainage secured. Patient made a good recovery.

Total	Bullet wounds	Shell wounds	Bomb wounds	Bayonet wounds	Suture	Suture with colotomy	Complicated	Recovered	Died	Ultimate history untraced
12*	4	5	2	1	6	5	4	5	6	1†

* This total includes two cases of multiple perforation of the colon from bomb wounds; they were complicated with wounds of the small intestine, and they have been dealt with under that heading.

† We have since learnt that this patient died.

Wounds of Spleen.

In two cases damage to the spleen rendered it necessary to perform the operation of splenectomy.

Morbid Anatomy.

In one case a bullet was responsible for the damage; it had passed through one pole of the spleen, tearing it into two portions and splitting it in all directions. One portion of the spleen could not be recovered from the abdomen at operation, it appeared later from the wound as a small slough. In this instance the kidney was badly damaged (Case 38). The second case was of even greater interest than the first, because apparently the injury to the spleen was not a primary but a secondary result.

The bullet had passed comparatively superficially through the left flank, fracturing the lower ribs in its passage; the sharp fragments of ribs had been drawn inwards and these fragments were responsible for the damage to the spleen. The movement of the spleen with each respiration had increased the damage, until at the time of operation the organ was reduced to pulp. This is the second instance we have seen of this form of injury to the spleen; the first was not under our immediate care.

Clinical Features.—The first case was observed about six hours after the injury was sustained. The general condition was wonderfully good, pulse being only 88 per minute; there was some muscular rigidity along the left side of the abdomen, the abdominal cavity contained a quantity of free fluid, and the temperature was normal. These, together with the entrance and exit wounds, were the only clinical evidences. The second case was different, in so far as forty-eight hours had elapsed since the receipt of the injury; during that time hæmorrhage had been continuous. When admitted the patient was pulseless, there were all the evidences of intense hæmorrhage; the abdomen was distended, rigid, and contained a large amount of fluid.

Treatment.—In both cases we found it necessary to remove the damaged organ; the idea of suturing could not be entertained. We made use of an incision parallel to the costal margin, and no difficulty was encountered in removing the part. Drainage was secured in the flank, and a Keith's tube was passed through a suprapubic opening into the pouch of Douglas. In the three cases which we have observed the injury to the spleen was complicated in two cases by damage to one of two other organs, the left kidney and the splenic flexures of the colon. It is advisable to take care during operation that these complicating injuries are not overlooked.

SYNOPSIS OF CASES.

Case 38.—Cpl. S. C., Royal Engineers. There was an entrance wound over the spinal column and an exit wound in the left loin, there was left abdominal rigidity and evidence of internal hæmor-

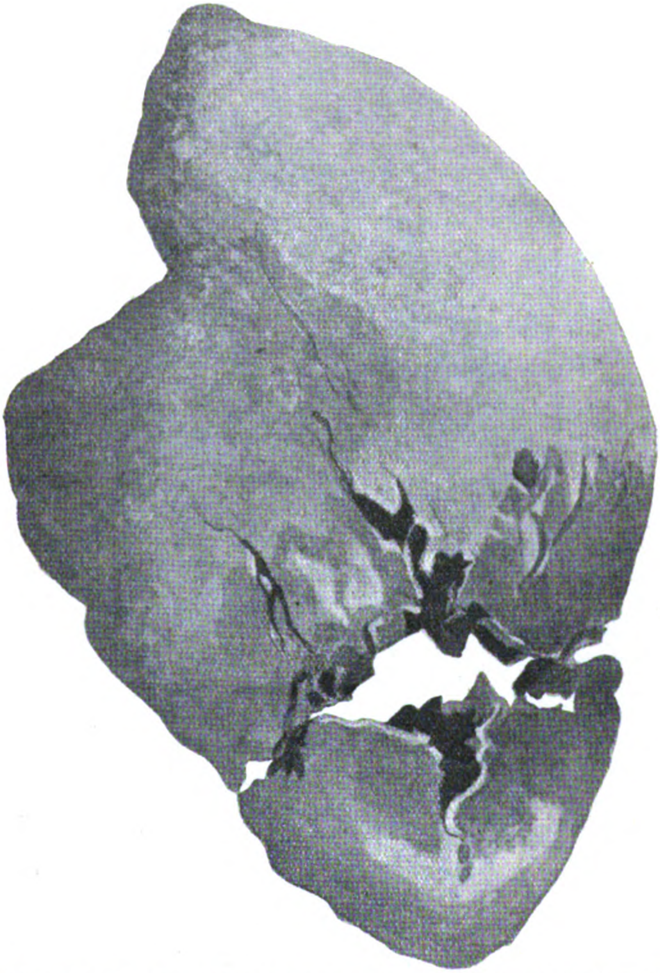

FIG. 12 (to illustrate Case 38).—Injury to spleen caused by rifle bullet. The lower portion was entirely detached and could not be recovered by operation. It was, however, recovered later.

rhage. The abdominal cavity was opened, it was found to contain a large amount of blood. The spleen was shattered, its pedicle was ligatured, and the remains of the organ removed; the left kidney

was so extensively damaged that its removal was also necessary. An uninterrupted recovery.

Case 39.—Pte. B. A., Grenadier Guards. This man was wounded in the lowest ribs, at the posterior axillary line, forty-eight hours before admission; the wound was produced by a rifle bullet. On admission the patient was pulseless, obviously suffering in-

FIG. 13 (to illustrate Case 39).—Injury to spleen caused by rifle bullet. It is probable that much of the resulting destruction was due to the viscus being torn by the indriven and fractured ribs.

tensely from hæmorrhage; the abdomen was distended and rigid. Upon opening the abdomen its cavity was found to be full of blood, the spleen was disorganized into a mass of bleeding pulp, the lower

ribs were fractured and their sharp ends had been driven into the spleen. The spleen was removed and the sharp bone fragments excised. Drainage was established in the flank and suprapubically. This patient died on the seventh day after operation; he apparently succumbed from heart failure.

RESULTS OF SPLEEN WOUNDS.

Total	Primary damage caused by bullet	Secondary damage by broken rib	Recoveries	Died
2	1	1	1	1

WOUNDS OF LIVER, GALL-BLADDER AND DUCTS.

In discussing wounds of this region we shall bring a series of thirteen cases under review, but it must be understood that only a relatively small proportion of these required operation.

Morbid Anatomy.

Our knowledge of the morbid anatomy of these cases is based entirely on operative experience; we have had no post-mortem experience.

The close relationship of the right pleura and lung to the right lobe of the liver is responsible for the fact that a wound of the liver is very frequently accompanied by damage to the overlying lung or pleura. This fact is important as the latter condition is apt to be overlooked. We have seen a case in which the lung wound had been unnoticed until the degree of fluid in the right pleura actually endangered the patient's life. It would appear to be unusual to have much destruction or disruption of the liver tissue; probably for this reason the occurrence of a post-traumatic jaundice is uncommon. There is generally an escape of blood into the peritoneal cavity, and occasionally it can be demonstrated in the retroperitoneal tissues.

We have only one instance to record of a wound of the ducts: a case in which the cystic duct was divided close to its entry into the gall-bladder. Duct wounds are so frequently accompanied by injury to large vessels that the result is generally fatal before they can be given surgical assistance.

Clinical Features.—The clinical features may be remarkably scanty. If the wound has involved the lung and pleura, the pulmonary signs frequently disguise the abdominal features. Generally there is pain over the liver and beneath the right

scapula. The pulse, temperature, and more especially the respiration, are increased. There is usually some rigidity of the upper part of the abdominal wall; we have observed that the rigidity is increased and becomes more generalized when there is a considerable effusion of blood into the peritoneal cavity. By percussion an effusion can sometimes be demonstrated in the right iliac fossa. One would expect greater interference with the excretory function of the liver than is actually the case. On only one occasion have we seen a large effusion of bile into the peritoneal cavity (Case 44). Post-traumatic jaundice is exceptional, and when it occurs it generally indicates a septic change secondary to the wound. There is no alteration in the bile contents of the fæces, and the urine is free from bile.

Treatment.—We have only operated on such cases as showed progressive hæmorrhage, or which from the clinical features we suspected to be complicated by wounds of other viscera. In one instance we operated for a wound of the cystic duct (Case 40). In another instance a late operation was necessary on account of the accumulation of bile in the peritoneal cavity. We have employed a Kocher's paracostal incision, or the angled incision recommended by Mayo Robson; both incisions have given excellent access. The operation has generally been confined to investigation, plugging and drainage.

Synopsis of Cases.

It is unnecessary to give details regarding the cases which were not operated on.

Operated Cases.

Case 40.—Serjt.-Major P. W., Connaught Rangers. There was an entrance wound below the costal margin with an exit wound behind. There was general abdominal rigidity, an increasing area of dulness in the right flank, and evidences of general collapse. The abdomen was opened through an angled incision, it contained a quantity of blood and bile. The gall-bladder was collapsed, and the cystic duct was divided close to its entrance into the gall-bladder. No other injury could be found, beyond some scoring of the under surface of the liver. The divided duct was drained with a "dressed" rubber tube. For two days there was a profuse discharge of bile; after that date it diminished and disappeared. Two months after the patient was in perfect health.

Case 41.—Pte. G. A., Royal Field Artillery. This man was

wounded by a shrapnel bullet, immediately above the right costal margin. His condition on admission was good, but some hours after admission signs of general peritonitis developed. The abdomen was opened; it contained a quantity of blood, and the upper surface of the liver was torn. The wound in the liver was drained with a dressed rubber tube. Patient made an excellent recovery.

Case 42.—Rifleman R. J., Rifle Brigade. There were entrance and exit wounds below the right costal margin and in the right loin, with general abdominal rigidity. The abdomen was opened and found to contain a quantity of blood. The under surface of the liver was torn and fissured. Drainage was secured with a dressed rubber tube. An uneventful recovery.

Case 43.—Pte. J. J., King's Royal Rifles. There were entrance and exit wounds in the right axilla and over the right kidney; the entrance wound was small, but the exit wound was large and admitted three fingers. The bullet had penetrated the liver, opened the extreme lower limit of the pleura, and passed through the extreme outer edge of the kidney. The wound was drained. For two days there were evidences of a urinary fistula. The discharge then ceased and an uneventful recovery was made.

Case 43A.—Pte. D. A., East Lancs. There was a large entrance wound over the tenth rib, caused by a fragment of common shell. The wound was enlarged, neighbouring ribs being resected. The fragment had opened the pleural cavity, torn the diaphragm, passed through the right lobe of the liver, and was removed from the muscles of the posterior abdominal wall. It measured one and half inches by three-quarters of an inch. Efficient drainage was established and an uneventful recovery was made.

Case 44.—Cpl. C. H. W., Royal Berks. There was an entrance wound over the right scapula caused by a shrapnel bullet; the bullet could be felt beneath the skin over the right costal margin. The projectile had obviously traversed the liver, but there being no abdominal symptoms no operation was done. Two days later slight jaundice developed, and there was free fluid to be made out in the abdominal cavity. The following day the jaundice had deepened, and the amount of free fluid had increased; the abdomen was therefore opened. The abdominal cavity contained a large amount of free bile. Drainage was established, and the discharge eventually ceased.

Cases 45, 46, 47, 48, 49, 50, 51 and 52 were not operated on.

Total	Bullet wounds	Shell wounds	Shrapnel bullet wounds	Pure wounds of liver	Liver wounds complicated with pleural wounds	Duct wounds	Re-covered	Died	Not operated on
13	7	6	1	8	4	1	13	—	7

Wounds of Kidney and Ureter.

We have had three cases of wounds involving the kidney, and one case in which the ureter was damaged.

Morbid Anatomy.

In regard to the kidney wounds, in two cases the injury was comparatively slight, necessitating only a simple drainage. In the third case the kidney was so badly damaged that nephrectomy was necessary. But the apparent triviality of the kidney wound is sometimes no guide to the organic disintegration which occurs. Even in the slightest wounds the organ shows extensive microscopical changes of minute necrosis and hæmorrhage.

Clinical Features.—In each of our cases we got our first indication of the kidney being damaged from the position of the wound. One would reasonably expect hæmaturia to occur; blood was present in the urine in the two comparatively slight cases with which we had to deal; in the severe injury the remainder of the pelvis of the kidney was blocked with blood-clot, and there was no indication of hæmaturia.

Treatment. — Generally speaking there are three possible operative procedures which one may be called upon to perform: (1) Simple drainage; (2) suturing the kidney; (3) nephrectomy. We employed the first procedure in the two instances in which the damage was slight; a "dressed" tube was passed down to the kidney wound and gauze was loosely packed around it. This method gave every satisfaction. We have had no suitable case in which to employ the second procedure.

One case demanded the operation of nephrectomy (Case 55). In this instance the spleen was removed in addition to the kidney; the operation was carried out transperitoneally.

In the majority of instances the operation will be done through an anterior incision by reason of the fact that it is necessary to examine not only the kidney but also the general abdominal viscera.

SYNOPSIS OF CASES.

Case 53.—Pte. G. F., Rifle Brigade. Wounded by a bullet in the left loin; the projectile passed across the back without damaging the spine and emerged on the opposite side. The left posterior wound was enlarged. The descending colon had been stripped forwards from the kidney, and the projectile had grazed the outer border of the kidney. Drainage was secured, and patient made a good recovery.

Case 54.—Pte. J. J., King's Royal Rifles. There was a small entrance wound in the right posterior axillary line; there was a large exit wound over the right kidney. The posterior wound was enlarged, and the eleventh and twelfth ribs were removed. The bullet had opened the pleura, damaged the liver, and passed through the outer edge of the kidney. Drainage was established; for two days there was a slight discharge of urine. Eventually recovery.

Case 55.—Cpl. S. C., Royal Engineers. There was an entrance wound over the spine and an exit wound in the left loin. There was left abdominal rigidity, and evidences of internal hæmorrhage. The abdominal cavity was opened, and was found to contain a large amount of blood. The spleen was found to be shattered to pieces; it was removed. Palpating the left kidney, it likewise was found to be in pieces. The peritoneum to the outer side of the colon was divided and the gut separated inwards; the remains of the kidney were removed; drainage was established in the flank. Recovery.

WOUND OF URETER.

We have had a single instance of this injury and we offer no comment beyond briefly describing the case.

Case 56.—Pte. R. J. W., Irish Guards. He was shot at close range in the abdomen by a machine-gun bullet. On operation there were found to be eight perforations in the small intestine. In addition to blood, the abdominal cavity contained a quantity of urine; this was found to have escaped from a wound of the left ureter, where it passed into the pelvis. As the patient's general condition was grave, no attempt was made to repair the ureter wound, but a drainage-tube was sutured in position, and drainage also established in the flank. In addition a resection of small intestine was perforated. After the second day there was no discharge of urine, and patient made an uneventful recovery.

RESULTS OF KIDNEY AND URETER CASES.

Total	Bullet wounds	Shell wounds	Drainage	Nephrectomy	Recoveries	Died
4	4	—	3	1	4	—

WOUNDS OF BLADDER.

We have had the opportunity of dealing with four of these cases; three of them were examples of intraperitoneal rupture; the fourth was an example of an extraperitoneal wound.

Morbid Anatomy.

There were two facts which impressed themselves upon us. The first was that an intraperitoneal wound of the bladder is in nearly every instance complicated by wounds of other viscera, usually the rectum and small intestine. The second fact is illustrated by Case 59, in which a non-penetrating wound of the abdominal wall, sustained by a man with a full bladder, may produce a rupture of the bladder. Details of the cases are added.

Clinical Features.—The clinical features which are observed were complicated by the symptoms of other wounded viscera, except in one case (Case 59).

The features were those of a somewhat slowly developing general peritonitis, with at first local pain over the bladder and afterwards diffuse pain. In the intraperitoneal rupture the presence of free fluid in the abdomen could be demonstrated; in the extraperitoneal rupture there was a wound in the perineum, from which urine mixed with blood was escaping. In the uncomplicated case the degree of shock was less than in intestinal injury.

Treatment.—In the intraperitoneal rupture we adopted the operative procedure of a suprapubic cystotomy; in the extraperitoneal variety it was found to be sufficient to drain the bladder *per urethram*, while a local drain was established in the perineum.

SYNOPSIS OF CASES.

Case 57.—Pte. W. J., Black Watch. There was an entry wound immediately above the symphysis pubis; there was no exit wound. There were all the signs of extensive damage to the abdominal viscera, and shock was intense. Eight hours had elapsed since the injury. Operation showed a perforation of both walls of the bladder, five perforations in the lower end of the ileum, and a tear of the

large intestine at the junction of iliac colon and pubic colon. The bladder wounds were closed and a suprapubic cystotomy done; the colon wound was sutured and a colostomy performed above; a length of two feet of small intestine was resected. Patient died of collapse about ten hours after operation.

Case 58.—Pte. H. B., Manchester Regiment. This man was wounded by a revolver bullet above and slightly to the left of the symphysis pubis; there was no wound of exit. There were the usual evidences of injury to the abdominal viscera. Operation showed a perforation of the bladder on its left lateral aspect, eight perforations of small intestine and a perforation of the iliac colon. A suprapubic cystotomy was done, the small intestine was resected and the wound of the colon treated by suturing and colostomy. The patient succumbed on the following day.

Case 59.—Cpl. C. L., 20th Infantry Brigade (German). This case is of special interest because we believe it to be an example of the rupture of a full bladder secondary to a superficial non-penetrating wound of the abdominal wall. There were entrance and exit wounds immediately below the umbilicus. Examination showed that these wounds communicated and were not perforating. There were, however, distinct evidences of infection inside the abdomen. There was no other evidence of wound or contusion. The abdomen was opened; it contained a large quantity of urine. The bladder wall was split on its antero-lateral wall, and the wound was partly extraperitoneal, and partly intraperitoneal. A suprapubic cystotomy was performed and intra-abdominal drainage secured. Unfortunately a virulent peritonitis developed, from which the patient succumbed.

Case 60.—Lance-Cpl. F. J., Royal Engineers. This man while bending forwards was hit by a rifle bullet in the perineum; the projectile emerged above the crest of the ileum, of the left side. There was a considerable degree of collapse. The abdomen was rigid in its lower part; the patient had passed some blood-stained urine, and blood was escaping from the rectum. Operative measures were carried out under spinal anæsthesia. The abdomen was opened in the middle line; there was a perforation of the mesentery of the iliac colon, the gut was not damaged. The bladder contained a quantity of dark-coloured fluid, urine mixed with blood, but there was no intraperitoneal perforation. The abdominal wall was closed. The patient was now placed in the lithotomy position. A full incision was made in the left side of the perineum and the wound opened up along the lateral aspect of the

rectum and bladder. Drainage-tubes were placed in position by the side of each organ. A large catheter was passed into the bladder *per urethram;* the bladder cavity was washed out and the catheter fixed in situ. The bullet in its progress had fractured the lateral wall of the pelvis. For two days the lateral bladder tube discharged freely; the discharge then ceased and the tube was removed. The urethral catheter was kept in position for five days. After fourteen days this man was discharged to the base.

RESULTS OF BLADDER CASES.

Total	Bullet wounds	Secondary rupture	Intra-peritoneal	Extra-peritoneal	Recovery	Died
4	3	1	3	1	1	3

WOUNDS OF THE RECTUM.

Under this heading we only include those cases in which injury was sustained by that portion of the large intestine which extends from the level of the third sacral vertebra to the canal.

Morbid Anatomy.

We have experienced two cases representative of this type of injury. In both instances the wound had been sustained in the left buttock; the bullet had at first pierced the gut extra-peritoneally, then emerging intraperitoneally it had produced further extensive damage in the small intestine. In both instances the lateral wall of the pelvis was fractured, and there was most profuse bleeding from the bone and the pelvic veins.

Clinical Features.—There were all the features which one associates with injury to the abdominal viscera, in addition recent hæmorrhage was escaping from the rectum. As a rule in these cases there is retention of urine, and if urine is voided pain is complained of in the region of the bladder. We have had no means of judging the degree of shock, which such a wound by itself would produce, as both cases were complicated by extensive damage to the small intestine.

Treatment.—We at first proceeded to open the abdomen. The wound in the rectum was sutured, and an inguinal colostomy performed; any repair of small intestine which was necessary was carried out. In both instances we further attempted to drain the extraperitoneal wound of the rectum by enlarging the entrance wound and passing a tube to the damaged wall of the

gut. Both cases unfortunately ended fatally; the shock produced by the damage to small intestine was apparently the cause of death.

Synopsis of Cases.

Case 61.—Cpl. H. J., Seaforth Highlanders. There was an entrance wound of the left buttock, and in addition there were the signs of injury to the abdominal viscera. There was no exit wound; the entrance wound was bleeding profusely. The abdomen was opened; there was a relatively small wound in the right wall of the rectum; there were six perforations in the lower end of the ileum, and the abdominal cavity contained a large quantity of blood. The wound of the rectum was sutured, and a colostomy performed; the damaged loop of small intestine was resected; the entrance wound was opened up, and as far as possible an extra-peritoneal drainage of the rectum established.

Case 62.—Pte. S. W., Connaught Rangers. There was a small entrance wound immediately below the left buttock; great abdominal pain was complained of, and there was general abdominal rigidity. The abdominal cavity was opened; the right lateral wall of the rectum was perforated and there were several perforations in the lower end of the ileum. The rectal wound was closed with sutures, and an inguinal colostomy was done; the damaged portion of small intestine was resected.

Results of Rectal Wounds.

Total	Bullet wounds	Simple wounds	Complicated wounds	Recoveries	Died
2	2	—	2	—	2

GENERAL REMARKS.

We are convinced that in the vast majority of cases of penetrating wounds of the abdomen operative measures offer the best chance of success. We would qualify the statement by excluding from the category uncomplicated wounds of the liver and certain wounds of the kidney. When the wound affects the hollow viscera of the abdomen, we are satisfied that it is only as the rarest exception that a spontaneous recovery occurs.

When these cases arrive in hospital they are almost universally in a state of intense collapse. We have therefore found it advisable to wait for a period of from one to two hours until the increased shock of the journey has subsided.

To this rule we make one exception; those cases which show evidences of rapid and progressive hæmorrhage; in such cases the risks attendant on immediate operation are taken.

During the interval of waiting it is difficult to decide whether or not active stimulant measures should be adopted. These cases are generally complicated by some degree of hæmorrhage, and stimulant measures in all probability tend to increase the bleeding; we therefore limit the pre-operative stimulation to getting the patient thoroughly warm and administering one cubic centimetre of pituitary extract.

During the operation every precaution is taken to minimize the degree of shock; the theatre is thoroughly heated, the table is provided with a hot-water bed; lately, we have found it advantageous to operate on these cases while they are in the Trendelenburg position.

Immediately before the operation commences the administration of subcutaneous saline by a Lane's bag is begun and it is continued throughout the operation; three to four pints of fluid are frequently given in this way. We have tried several different methods of anæsthesia. We have had good results from the use of spinal anæsthesia, but there is difficulty in obtaining the freshly prepared anæsthetic, and it would appear that this is an important detail. In two instances we have had patients collapse suddenly after the administration of this anæsthetic. More lately, and on the suggestion of a paper by Yandell Henderson, we have employed closed ether anæsthesia. The paper above mentioned deduces evidence to show that by this method of anæsthesia shock is considerably lessened.

The method has given us great satisfaction. Briefly, the operative technique which we have employed is as follows:—

The abdomen is opened in what would appear to be the most suitable situation and generally in the middle line. A large incision is employed. If the abdominal cavity contains a large quantity of blood, sufficient of this is rapidly swabbed away with a long roll of dry gauze to clear the view. A systematic examination of the various viscera is now carried out. We begin by picking up the cæcum and recognizing the ileo-cæcal junction; we work back rapidly along the whole length of small intestine, examining not only the gut but also its mesentery. The large intestine is reviewed, special attention being paid to the various flexures. If necessity arises the stomach on both aspects, the duodenum, the liver, and spleen are examined. It is a wise precaution to palpate both

kidneys, especially the left kidney, in cases of damage to the spleen. The pancreas is reviewed during the examination of the posterior wall of the stomach. The pelvic viscera are examined last, and to facilitate their examination the residual hæmorrhage is more completely cleared away. The question arises whether or not the abdominal cavity should be washed out. In early cases with extensive soiling of the peritoneal cavity we have done so; in later cases and in those which showed evidences of peritonitis we have not done so. We have found it sufficient to establish drainage by a single Keith's tube, passing into the pouch of Douglas. In special instances, such as have already been mentioned, we have found it necessary to drain locally or in the flanks. We invariably close the abdominal wall with through-and-through sutures of silk-worm gut, guarded where they pass over the wound junction with small pieces of capillary rubber tubing. A Doyen's handled needle is the ideal instrument for inserting these sutures.

Throughout the operation, speed is an important factor, coupled with every possible avoidance of shock. As regards the post-operative treatment, there is very little which we wish to add; it is similar to that of every other abdominal operation. Special attention is paid to the administration of fluids; for choice by the administration of continuous rectal salines, and by subcutaneous infusions.

One is frequently asked regarding the prognosis of these cases. There is this fact to be recognized, that one must be prepared for repeated most bitter disappointments, but when one comes to view a series of cases the gains seem infinitely greater than the losses. The prognosis, of course, very largely depends on the degree of the injury sustained, but an even more important factor is the length of time which has elapsed since the injury was sustained. Early operation offers the best and surest chance of ultimate success. In reviewing the statistics of the results of such operations as these, it is impossible to consider the question *en masse*. Each individual case must be considered, for the chances of success depend upon so many factors that it varies enormously in different instances.

We wish to acknowledge our indebtedness to Colonel Cuthbert Wallace, for his encouragement and advice; also to Lieutenant-Colonel Wear, C.M.G., R.A.M.C.(T.), for permission to record these cases. The illustrations are the work of Serjeant Wilson and Private Warr, R.A.M.C.(T.).

CONTRIBUTIONS TO THE STUDY OF SHELL SHOCK (III): BEING AN ACCOUNT OF CERTAIN DISORDERS OF CUTANEOUS SENSIBILITY.

BY TEMPORARY LIEUTENANT-COLONEL CHARLES S. MYERS, M.D., Sc.D., F.R.S.
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IN my first communication on this subject,[1] I described three of the earliest cases of severe shell shock I had seen, which were characterized especially by defects of memory, vision, smell and taste. Among the large number of cases which have since come under my observation, I have met (in about twenty-five per cent) with various disorders of cutaneous sensibility, some distinctive features of which form the subject of the present contribution.

OVER-REACTION AND "HYPERÆSTHESIA."

The following is a pronounced instance of general over-reaction:—

Case 9 (Case Number 227).—Stretcher-bearer, aged 19, with eighteen months' service, and six months' service in France, was seen by me the day after admission to a base hospital. Four days before admission he had been "blown up three times by aero-torpedo trench mortars" while attending to the wounded in the trenches during an enemy attack. He said that one had blown him in the air, that another had blown him into a dug-out, and that the third had knocked him down, but that nevertheless he continued his work of carrying away the wounded to the dressing station. Two or three hours later, after he had finished, he was resting in a dug-out when "everything seemed to go black" (probably he had a hysterical "fit") and he became "shaky," and had remained so ever since. He said that he had hardly slept for seven days before he "gave in."

He appeared an honest, courageous lad, but was obviously in a very "nervous" condition, making irregular spasmodic movements of the head, arms (especially the right) and legs (especially the left). There were well-marked coarse tremors and inco-ordination during voluntary movements of the arms. He touched his nose with far greater uncertainty when his eyes were closed. The lightest touch of cotton-wool on the limbs or head provoked very lively movements; obviously he dreaded the next touch. "I was

[1] Published in the *Lancet*, February 13, 1915.

always ticklish," he explained, "but never like this. I can't stand it, sir." A pin-prick produced a series of most violent spasms, almost amounting to a convulsion. He sweated considerably during examination. There was much rigidity in the legs, and so much spasm that a knee-jerk was unobtainable until my second visit the sixth day after admission. Plantar stimulation gave a flexor response. He suffered from visual hallucinations of bursting shells; he also heard them when dozing.

He improved considerably with rest and treatment; but seventeen days after admission, lying asleep in bed outside his tent in the sunshine, he woke to find himself being carried back in his bed owing to a sudden shower of rain. This brought about a recurrence of such terror that a special nurse was considered necessary that night. The next day he was still very "jumpy" and alarmed, even at the sound of a footstep; he complained of severe headache. Three days later he had again improved and was transferred to England.

Cases like this, of general over-reaction, appear to be very rare after shell shock. But I believe that they may be regarded as an extreme form of the far commoner condition of unilateral or otherwise more restricted "hyperæsthesia"; and for this reason (based on considerations which will appear immediately) I place the word in inverted commas. Such local "hyperæsthesia" was specially apt to occur over areas which were the seat of spontaneous (subjective) painful sensations. Unilateral "hyperæsthesia" was combined in several cases with contralateral anæsthesia or hypæsthesia. In others it was sometimes difficult to be sure whether one side of the body was subnormally sensitive or whether the opposite side was supernormally sensitive, although, as a rule, the patient's "jumpiness" and muscular over-reaction afforded a sufficient clue to the latter condition.

The Nature of the "Hyperæsthesia."

Several cases of "hyperæsthesia" presented features recalling to my mind those which have been emphasized by Head and Holmes[2] in their observations on lesions of the optic thalamus, and which have been attributed by them to a loss of the inhibitory control normally exercised by the cerebral cortex over the activity of the thalamus. They compare this loss of cortical control over the thalamus with the loss of cortical control over the bulb and cord;

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[2] *Brain*, 1911-12, vol. xxxiv, pp. 102 to 253.

just as the latter manifests itself in muscular rigidity, increased reflexes, etc., so the former results in sensorimotor and effective over-reaction. In such thalamic over-reaction a cutaneous stimulus produces abnormal motor response, excessive tingling and diffuseness of sensation, and increased affective reaction of pain or pleasure.

With the most careful avoidance of suggestion on my part, various patients suffering from "hyperæsthesia" after shell shock have given me the following observations—cotton-wool "tingles more" "tingles and runs right up," "is more tingling," "tickles more," "is more ticklish," "itches more," "is more itchy," "gives me an awful feeling, a tingling tickle with an after-itch," "I can't stand it, sir." A pin-prick is "like an electric current," "more like an electric shock," "stings like a bee," "shoots up the arm," "seems to run up more" (from foot to knee), "shoots more than usual up the leg and lasts longer as an after-tingling," "is sharper and itches more."[1]

As would be expected, such over-reaction when limited to one side of the body, usually made localization of the spots touched on that side distinctly more difficult and more inaccurate than on the normal side. No doubt the spatial threshold would have been raised, but I have not yet applied the compass tests to such cases.

Clearly, far closer inquiry is needed to establish more than the superficial resemblance which is here indicated. In view of the relation already recognized between emotion and, on the one hand, shock, and on the other, thalmic activity, such an inquiry would have especial interest. Unfortunately (or fortunately, in relation to freedom from prejudice) the relation was not in my mind when these observations were recorded.

As Head and Holmes observe, the paths of cortical control "come from all parts of the cortex to impinge on the thalamus" (p. 179). No doubt in unilateral lesions of the optic thalamus many of the striking features observed are due to the more or less complete and abrupt *structural* severance of the thalamus of that side from the sensory areas of the cortex. But, in the cases with which we are now dealing, the interruption, if it occurs, is of a *functional* character, and the cortical centres here deprived of their normal inhibitory action are situated far "higher" than those of which we have at present any topographical knowledge, acting,

[1] It was this kind of disturbance of sensibility which was alluded to in Case 5, described in my communication to the *Lancet* of January 8, 1916.

it may even be, not directly on the thalamus, but through intermediate levels. As they stand, the patient's replies indicate a sensory as much as an affective over-reaction. And in this connexion we may recall certain features of what Head and his fellow-workers have called "protopathic" sensibility, where one peripheral system of sensibility obtains full play—no longer controlled by the inhibitory influence of the higher ("epicritic") system—yet another instance of unleashed primitive sensibility.

In any event, then, we should not expect to meet with the *syndrome thalamique* of Roussy, with its hemi-anæsthesia, hemi-ataxia, slight transient hemiplegia, persistent paroxysmal pains on the affected side and irregular athetoid or choreic movements. It is, however, noteworthy that the last of these symptoms is said to occur in less than half of the observed cases, while the first may be so slight as only to be revealable when the stimulus strength is carefully measured; indeed, in thirteen of the twenty-two cases observed by Head and Holmes the pain threshold was equal on the two sides, and in five of their cases the threshold for the light touch of hairs was equal on the two sides. But *in no case* did these observers meet with a lowered threshold, i.e., a *true hyperæsthesia,* on the affected side, although the affective over-reaction was throughout a characteristic feature. The patient typically replied that a prick was less sharp and less plain over the affected side, although it hurt him more, and in several cases an actually higher threshold was found on that side.

We have therefore to consider whether the "hyperæsthesia" which is met with in certain cases of shell shock is the outcome of genuine increase in sensibility or whether it is not due to sensory diffuseness and increased affective response. At first sight, it would appear that this question could be settled by comparing, in hemi-hyperæsthetic patients, the thresholds to pain or touch of the two sides. But even had I had the opportunity of employing an algesimeter or von Frey's hairs in suitable cases, I am very doubtful if any accurate readings on the affected side would have been obtainable. For in the case of pain, at least, it would always have been difficult to ascertain whether the patients were responding to the minimal sensation of pain or of touch, or to the dreaded discomfort which they expected the stimulus to produce, so "jumpy" was their invariable condition. Moreover, it is quite conceivable that even if the *threshold* for pain and touch were found normal, the *sensation* might nevertheless be abnormally strong after once that threshold had been passed, that is to say, when the stimulus was powerful enough to give rise to any sensation at all.

In this connexion attention must be drawn to the fact that in several of my cases the condition of "hyperæsthesia," whatever may have been its nature, passed over into one of distinct hypæsthesia, without, however, losing all its features. Thus one patient, during a stage of mutism had shown unilateral (left) "hyperæsthesia," which twelve days later gave place to diminished sensibility; whereupon he complained that "the prick is more numb on this (left) side and seems like a blunt point, but I feel it more because it shoots more," and he averred that light touch "tingles up the left side, but it does not feel numb on the right as it does on the left."

In another case, the state of "hyperæsthesia" over an aching, tender, "jumpy" abdomen (across which sandbags had been blown through a shell explosion) was accompanied by "dulness" to cotton-wool over that area. In yet another, previous "hyperæsthesia" of the right leg and foot ("it seems to jab all over") was followed by a "sleepified pins-and-needles feeling" in the right calf, but the prick still seemed "to run up more" than on the left side.

Another case is noteworthy, of loss of sensibility on one side, on which patches were found giving a sensation to pin-prick of "tickling like a hair, more ticklish than usual, felt over a wider area" than on the opposite side.

Anæsthesia.

But whatever be the cause and nature of the disorders of sensibility already considered, there can be little doubt as to the origin of the far commoner (2 : 1) condition of simple anæsthesia or hypæsthesia. It is the outcome not of relaxed control but of dissociation or inhibition in the higher cortical regions. How far suggestion plays a part in this process may be deferred for the present; I need only now remark that I was alive to the possibility of the anæsthesia being produced by medical investigation and took every precaution to avoid it.

The loss of sensibility varied considerably in degree. In the slightest cases it could only be demonstrated by comparing normal with abnormal regions of the skin surface. Loss of pain was commonest, the prick of a pin being (*a*) merely dulled, or (*b*) recognized as the end of a match or pencil or as my finger or finger-nail, or (*c*) not even felt as a touch. Only in the severest cases was sensibility to deep pain lost.

Defective power of localization (because "I can't feel it so well") was often present over hypæsthetic areas. Thermal sensibility

was also found to be defective when there was pronounced loss of sensibility to light touch and pain, hot or cold stimuli appearing less hot or less cold over the affected areas. The surface temperature, especially of the extremities, was sometimes very cold; and in one case a bilateral difference of body temperature accompanied a bilateral difference of sensibility to light touch, to superficial and deep pain, yielding correspondingly different answers to moderately warm and cool stimuli on the two sides owing to the different "temperatures of adaptation" thus arising.

Sometimes such anæsthesia or hypæsthesia arose immediately, especially in patients who had been buried; and in several of these cases, as we shall see, the loss of sensation occurred in regions which had become painful or numb after being hit by sandbags or other objects. In other cases the onset occurred later, and was more widely distributed. It then appeared to be the result of emotional shock (terror, horror, or anxiety), often uncomplicated by initial bodily pain, but almost invariably subsequent to a period of amnesia.

Hemianæsthesia.

It was especially in such cases that the condition of hemianæsthesia, so well known among hysterical patients, occurred. The two following cases may be cited as instances of this condition. In the description of them, and henceforth in this article, the words anæsthesia and hypæsthesia will be used in their narrower sense of defective sinsibility to *touch*, while analgesia and hypalgesia will be employed for defective sensibility to *pain*.

Case 10 (Case Number 126).—Rifleman, aged 33, with twelve years' service, and five months' service in France, was admitted to a base hospital for inquiry into his mental condition, he having wandered from his post without permission five weeks previously. On admission he appeared to be in a state of semi-stupor typical of the state following shell shock, unable to say why he had been sent to hospital; replying, "I don't know," to nearly every question, and only slowly able to recall the names of his children, but able to give their ages. He later admitted to past abuse of alcohol. He complained of right frontal headache. His right arm was very tremulous even when at rest, and the grip of the right hand was distinctly weak. His knee-jerks were somewhat exaggerated; his plantar reflexes were flexor; his abdominal reflexes were not obtainable. He stood and walked naturally; no Rombergism. His pupils reacted normally to light; no nystagmus.

Two days later he seemed distinctly brighter. On investigation of his cutaneous sensibility, he proved to be totally insensitive to pain and light touch on the right side of the face, tongue and trunk, and on the right limbs. Sensibility to deep pressure, as tested by Cattell's algometer on the thumbs, was completely absent on the right thumb but was normal on the left. The compass test showed a normal spatial threshold on the left side; on the right side, of course, the threshold was unobtainable. With eyes closed, he distinguished a penny from a watch successfully held in the right hand, terming the former "sharp," the latter "a piece of glass"; he named them at once when held in the left hand. The vibration sense was wholly lost on the right side, save on the right temple, where it was feeble as compared with the normal left side. He failed to recognize in which direction his right hallux was moved, and failed to appreciate passive movements of his right arm; nevertheless, he was able to imitate with his right arm the position in which his left had been placed. Sensibility to temperature not examined. Tested for smell and taste, he showed complete right hemianosmia and hemiageusia to all smells and tastes; left side, normal.

The left ear heard normally, the right was almost completely deaf. The sound of a tuning-fork placed on the vertex was localized in the left ear. Otoscopic examination revealed no abnormality. The right visual field was limited to the fovea, the left was normal. The visual acuity of his right eye was $\frac{4}{18}$, of his left $\frac{4}{6}$. His right eye could only read Jaeger type No. 14, whereas his left read No. 2.

Case 11 (Case Number 94).—Serjeant, aged 32, with eleven years' service, and eight months' service in France, was admitted to a base hospital for inquiry into his mental condition, he having been charged with malingering. For seven years before the War he had been teaching in an Army school. On arrival in France he had at once found the heavy marching too much for him. He had fainted several times during the retreat from Mons, and during the fighting on the Aisne, where he had reported sick for dysentery. He stated that on that occasion he went to a field ambulance for two days and that, owing to the bursting of shells, one of which struck the ground and knocked him into a ditch, the ambulance was forced to move for shelter into a cave. Since then he had suffered from tremor which, he stated, was much worse when he moved his limbs, was addressed, or felt himself watched. After discharge from hospital, he had been employed for three months as

dispatch-rider on a motor cycle, but he lost his nerve for this work and was then given the duty of taking charge of fatigue parties. Again he had found the work, "long distances and long standing" too much for him. Finally, the charge of malingering was proferred against him. He had always been a total abstainer.

He was a very nervous, delicate-looking man, with widely dilated pupils, prominent eyeballs, a pronounced tremor of the right arm, and a pulse frequency of 102. No signs of goitre. The tremor was markedly diminished when he was left alone, and was increased, extending to the head, when he stood, and to the left arm when both arms were outstretched. He could control the tremor to a certain extent. He complained that he frequently woke at night, but said that he had no dreams. He had noticed that he forgot the names and faces of people he had known and the earlier parts of books he read. Memory tests demonstrated the defective state of his memory. He said that he felt very despondent and exhausted after the railway journey to this hospital.

Two days after admission he said that he had slept much better last night. Pupils much smaller this morning. Pulse-rate 75. Sensibility to light touch normal. Sensibility to pain distinctly reduced over the whole of the right side of the head and body and over the right limbs. He generally described a prick of the right arm or leg as the touch of my finger.

There was almost complete hemianosmia and complete hemiageusia on the right side; peppermint, eucalyptus and opium being only smelled by the left nostril, ammonia being termed "cold" to the right nostril, ether having a "faint" smell, while both were at once recognized by the left nostril. Visual acuity—right eye read two letters, left eye all letters at $\frac{5}{5}$. Right eye read only a few words of Jaeger No. 1, and then the print blurred; left eye read this type easily. Visual fields—general limitation in right eye; normal in left eye. Hearing not examined. Patient transferred to England.

The Influence of Past History.

About two-thirds of the cases of disturbed sensibility were accompanied by spontaneous (subjective) disorders of sensation, or by disorders of movement. Local aching, tenderness, muscular over-reaction, rigidity and spasms were common accompaniments of "increase" of sensibility; similarly, local numbness and tremor, paresis or palsy often went with loss of sensibility. Into the details of these disorders it is hoped to enter on another occasion.

Such disorders could often be successfully traced to actual blows upon the region in question due to the impact of sandbags or other objects, or to the patient's fall after being lifted or pushed by the force of the concussion.

But in a considerable number of cases the site of the sensory disorder caused by the shock was determined by a previous history of pain in that region. For example, one patient who had suffered four years previously from "ruptured kidney with blood in the urine" after a football match, complained of pain in his "back and kidneys" after being buried by a shell. Another who, on admission, complained of pains in the back when he breathed, gave a history of severe pleurisy from which he had suffered twelve months previously. Yet another who, after being lifted by a shell began to suffer from such pains in the left lower costal region and of pain in the left leg, recalled that he had had pleurisy on that side many years ago, and that a piece of glass once entered his left leg from which, he believed, it had never been removed.

In relation to the natural question as to how far the earlier experience may be actually revived in consciousness the following case deserves mention:—

Case 12 (Case Number 452).—Private, aged 26, with eleven months' service and one month's service in France, was admitted the day after shock to a base hospital. The concussion produced by a shell had caused the dug-out in which he was standing to collapse. The props gave way and a beam hit him on the left side of his face (he pointed to a bruise on the face). It forced him forwards to the ground on his right side, and pinned him there; at the same time a piece of corrugated iron fell on the left side of his back, and his right leg became pinned by a cross-beam which fell on the back of his thigh. He did not lose consciousness, but was merely dazed. "I had about three tons on top of me," he explained; "one of my mates had both legs broken and the others were badly shook up. The rest of the platoon dug us out. Two men helped me to the dressing station." He had been able to walk since, but complained that he had a pain in the right groin, and that his right knee gave way.

He was quite certain that about fifteen minutes after the accident he told "one of the other fellows" that he had "no feeling" in his right thigh. His medical officer did not arrive until about half an hour later. This feeling of "numbness" (as he calls it) "increased," he says, "until the day before my first visit, when the right thigh was found to be totally analgesic, to the level of the

upper margin of the patella, save for a narrow strip in the mid-line on its posterior aspect. Since then the 'numbness' feeling" of the thigh had improved, and correspondingly I found that whereas the thigh was now generally hypæsthetic and hypalgesic over its anterior surface, the only area of complete anæsthesia and analgesia was on the outer side of the lower half, the posterior surface having regained its normal sensibility.

He explained that three years ago he had been buried four feet deep in a brick-yard beneath a heap of clay which fell upon him. "I felt it most," he said, "in the right leg. I fell face downwards, like this time. My thigh was stiff and sore, not numb as it is this time. The back of it got black and blue." He admitted that the present accident *immediately* reminded him of his previous experience.

There was slight weakness of the lower facial muscle on the left side, of the left orbicularis palpebrarum, and of the arms, but no tremors nor any disturbance of sensibility on the face, arms, chest, back, or abdomen. The left buttock, across which a plank fell, showed diminished sensibility to cotton-wool. ("It feels number"), while a prick felt "like a match," until the point was inserted deeply, when it was recognized as a prick, but the pain was "duller" than over the right buttock.

Sensibility to warmth and coolness and to the vibrations of a tuning-fork was diminished over the right thigh, especially over the anæsthetic and analgesic area, where sensibility to deep pressure and to deep pain was also very markedly diminished. No threshold could be obtained over this area with the compass tests. Visual fields and taste and smell seemed unaffected. The corneal and conjunctival reflexes were diminished. No jaw-jerk was obtainable; the palatal, pupillary, abdominal and plantar reflexes were normal. A knee-jerk was just obtainable with the aid of reinforcement on the left side, but not on the right.

Three days later the left buttock had regained its sensibility, and the small area of total cutaneous anæsthesia and analgesia on the right thigh had become one of hypæsthesia and hypalgesia, with corresponding improvement in the sensibility of the rest of the thigh. He was now up and feeling very much stronger. He was sent to a convalescent camp.

Even in cases where there could have been no actual hurt from the effect of the shock, the subjective disorders produced could occasionally be elucidated by recourse to the previous history of the patient. For example :—

Case 13 (Case Number 330).—Private, aged 22, with thirteen months' service, three months' service in France, seen by me in a casualty clearing station the day after admission. Two nights before my visit, he had been out in a wood getting timber, when a shell came falling at some distance, about a hundred yards from him. He said he would not have minded it, had it not been for the dead lying in the wood, he having just picked up a human head which in the dark he had mistaken for a piece of wood. The shell did not knock him down. He fell among the dead, and remembered no more until he found himself running out of the wood, whereupon he again lost consciousness, on recovering which he found two stretcher-bearers helping him, with whom he returned. He was a big, burly fellow, complaining of pains in the back. On questioning him, he told me that he had had exactly the same pain eighteen months previously, when he was hit in the back while at work in a coal-mine, and had been obliged to rest for fourteen days.

It is clear, then, that such past injuries and diseases had not passed away without leaving a "memory" behind them, ready to be awakened, not necessarily with recognition, on a subsequent shock to the mental system. I may add that I have met with similar revivals of other past disorders after shell shock.

Spontaneous Spread of the Disorder.

In many cases (e.g., Case 12), the anæsthesia spontaneously cleared up without any suggestion and despite occasional examination. But in a few instances evidence was forthcoming of a gradual spread of the subjective sensory disorder and an increase of the insensibility to pain after its first onset. For example:—

Case 14 (Case Number 129).—Stretcher-bearer, aged 44, with eleven years' service, and two months' service in France, was admitted into a base hospital and seen by me there eight days after reporting sick. He stated that three days before this, while sheltering in a cellar, a shell jammed the door and that poisonous fumes from it entered the cellar. Later in the day, in another cellar, he was blown off his seat by a shell, and his "surgeon and five men got laid out." That day and the two following days he was continuously shelled and he "worked at the wounded without any rest," afterwards returning to his regiment. Then he lay down, but on waking found himself useless in the left arm as if there was "something wrong with the circulation," it "feeling numb and

cold." This persisted, but *the numbness had since spread* to the legs, especially the left. He complained of continual tingling in the terminal joints of the fingers of the left hand.

There was distinct *hypalgesia* over both forearms and hands, especially on the left limb; over the dorsum of the left hand there was total analgesia.

Two days later he said, " I can now feel articles I am touching. I could not before. They are only numb now in the early morning. The tingling comes on when the numbness is passing off. But to-day the hands and forearms showed a *total loss of sensibility* to pain everywhere, save over a small area on the flexor surface just below the elbow-joint."

The Effects of Protracted Examination.

Improvement.—In this case the second occasion of examination showed a more severe loss of sensibility to pain than had been found on the first. Often, however, especially in those cases in which a spread of defective sensibility had occurred, a distinct improvement could be brought about by examination, provided that it was long enough continued at any one sitting.

Thus one patient, after being blown over by a shell and, later, frightened by another, developed hypæsthesia and hypalgesia over the left side of the chest down to the nipple line, over the left arm down to the elbow, and over the forehead, especially on the left side. The first few pin-pricks applied to the face were unfelt, the next were described as my finger-nail, but finally they produced a definite sensation of pricking pain. On the following day he felt far less shaky, his hands had almost lost their previous tremulousness, his pupils were less dilated, and no difference in sensibility could be distinguished between the two sides of the chest and the two arms.

Other cases showed similar recovery during examination. One patient, for example, who by his bravery had won the Distinguished Conduct Medal, showed very marked hypalgesia and slight hypæsthesia over the left arm and slight hypalgesia over the right arm; but after a series of deep pricks which were felt the arms regained their normal sensibility. In another case, light touches over the right thigh and buttock tingled more, and pricks over the right legs stung more than on the left side, and the skin over the lumbar spines was almost totally anæsthetic to light touch and stung more to prick; but after an

examination of the normal surface of the skin higher up on the back the lumbar region recovered its sensibility.

Deterioration.—On the other hand, certain cases, in the course of prolonged examination showed deterioration in sensibility. Thus in one patient the bilateral differences became more marked, a state of hypalgesia becoming apparently one of analgesia, the subject being at length unable to distinguish (almost solely on the affected side) between the head and the point of a pin. This deterioration often appeared to result from the onset of a "jumpy," "nervous" condition, a state of mental confusion occasioned by the examination.

Perseveration.—Yet another change in the answers obtained during investigation was the outcome of perseveration—i.e., of persistence of response. In one patient, for example, who had suffered from stupor and mutism consequent on shell shock, the flexor surface of the left forearm and palm were "hyperæsthetic" and "hyperalgesic" and the left side of the forehead and *chest* were "*hyperalgesic*," while over the back of the neck and over both scapulæ (where the patient complained of pain) a state of complete anæsthesia prevailed. This order was that in which the examination was at first carried out. Yet when later the applications of cotton-wool and pin were begun over the back of the neck and shoulders and extended on to the chest, the condition of *anæsthesia* was found to spread over *both sides of the chest* down to the nipples, the left arm remaining in its former condition.

These three features, of improvement through experience, of deterioration through mental confusion, and of perseveration, are well exemplified in the two following cases.

Case 15 (Case Number 332).—Private, aged 23, with five years' service, and five months' service in France, was seen by me the morning after admission to a casualty clearing station, having been buried a few hours before admission by a shell while he was in a dug-out. He said that he had come to himself shortly before my visit, and had no recollection of being moved here. He was alone in the dug-out when it was shelled. He admitted to having "felt very bad lately" owing to the depth of water in the trenches, and was recently kept back for two or three days for observation by his regimental medical officer before being sent back to the trenches. His general appearance, I find recorded in my notes, was that of one "who has control over a stormy sub-surface which might at any time get the upper hand and result in a hysterical attack." He complained of headache and of buzzing noises

in the ears. His pulse-rate was 96. His visual fields were distinctly restricted. His palatal reflex was absent. A jaw-jerk was present. His patellar and plantar reflexes were normal. He stood unsteadily, especially swaying when his eyes were shut. He showed no tremor of the hands or tongue. His left arm was anæsthetic to light touch. He could not distinguish the point from the head of a pin applied to his left arm. When it was pricked he said that my finger was pressing. The right arm showed normal sensibility; but at first, over the right biceps, he momentarily carried over the immediately preceding answers of the opposite side, unable, but only for a few seconds, to distinguish the head from the point of a pin. On subsequent re-examination of the left arm, continual pricking resulted in a recovery of sensibility to pain over the flexor surface of the forearm, and at length the back of the hand became sensitive to light touch; but on the extensor surface of the forearm and elsewhere on the limb nothing whatever was felt. His forehead and cheeks were rather more sensitive to light touch on the left side, but pain was felt equally on the two sides.

At first he said that the left side of the chest was more sensitive to prick than the right, and then he carried this difference over to the upper arm until the forearm was reached. Whereupon the difference of sensibility became reversed, the right forearm alone feeling the pain as before. This reversal to his previous answers persisted as the pricks were continued upwards over the upper arm, until on re-examination of the chest he declared that there was no difference between the two sides either for light touch or for prick. The rest of the body showed no disturbance of sensibility.

Case 16 (Case Number 46).—Corporal, aged 39, admitted in a very depressed condition into a base hospital after working under shell fire at barbed-wire entanglements, complaining of noises in the head, pricking pains in the body, unsteadiness of the legs, general fatigue, irritability and loss of confidence, and want of interest in his work. He was a big, robust-looking man, showing very tremulous movements of the arms and legs, especially during movement. His gait appeared normal, but he stood very unsteadily with his eyes closed. "I'm strong enough," he explained, "but only a bit shaky. My legs have been very unsteady, especially when someone is looking at me. They must have thought me drunk at times." He showed a pronounced inability to touch any prescribed part of the body with his eyes shut. His head and tongue were

very tremulous. His pupils were equal and reacted normally. His knee-jerks were exaggerated; no ankle clonus; plantar responses flexor.

He volunteered the statement that "When I stand, it feels like standing on cotton-wool." His soles proved to be totally insensitive to light touch and to pain; sensibility to deep pressure was retained. But further trials, especially when aided by comparison with the effects of stimuli applied to the dorsum of the feet, resulted in the gradual return of right answers. Tested with warm and cool tubes, he at first called both the tubes "cold" when applied to the soles, and he gave generally wrong answers over the dorsum of the feet, often wrong answers over the legs and occasionally wrong answers over the thighs. Yet over the arms he was invariably correct, and when stimulated to attend by such injunctions as "Now, O——, attend well, you know what this is," he gave correct answers over the legs and dorsum of the feet and usually over the soles. But in the course of further examination his legs became very markedly tremulous, "A silly childish fear came over me" (as he explained it); his hands began to "feel cold and clammy" and, at the height of this "attack," he replied "Hot" or "Cold" even when the tubes were not being applied at all to his skin, evidently suffering from hallucination.

So, too, a few hours later, during re-investigation of the sensibility of the soles of the feet to pain, he finally repeated, "You're pricking me," when the pin's head was applied instead of its point.

When the compasses were applied to the dorsum of the left foot (sometimes two points, sometimes one point, being presented in irregular order) his answers to the two-point touches, when separated by 4 centimetres, were all correct. At 3·5 centimetres he made one error in ten two-point touches. At 3 centimetres, his answers became very incorrect. Returning now to the distances of 3·5 centimetres and of 4 centimetres, I obtained extremely incorrect replies for the two-point touches. At 5 centimetres his replies were correct for the two-point touches, but he made occasional mistakes in the one-point touches, as he had done at the outset when the two points were separated by 4 centimetres, whereas he had made none for the one-point touches when the two points were separated by distances of 3·5 centimetres and 3 centimetres.

I have seen several other cases showing the effects of perseve-

ration, improvement with practice, and deterioration through confusion, inattention, or fatigue. In all the cases showing perseveration and in all showing improvement with practice, there was evidence of exhaustion preceding the shock. Now it is especially in such cases that we should expect to find a state of instability in portions of the central areas which have been functionally affected by the shock, the inhibition or the loss of control being at one moment manifest, at another quiescent, according to the conditions of examination. In these and in other cases it is conceivable that certain cutaneous areas are hence in a state of "hesitating" sensibility, on a knife-edge, as it were, ready to be influenced in one or other direction by the past replies given to stimuli applied elsewhere, by the summation effects of stimuli, by unconscious suggestion on the part of the investigator or by express counter suggestion on his part. Thus we may account for the occasionally wide variability of replies, with which I have met, made by the same patient (1) at any one sitting (one apparently honest fellow, for example, when brought to book for his inconsistent replies, retorting, "All I can say is what I feel,") (2) at different sittings with the same or (3) with a different investigator.

None of the cases showing deterioration in replies through confusion, hallucination, inattention, or fatigue was under treatment for purely the immediate effects of shell shock. Two of the cases have been already described (Cases 11 and 16), another was that of a serjeant who had previously been invalided for overwork to England, three months after his return from which he fell to the ground during a bombardment when two guns close to him were blown out of action; since then his legs had been feeling weak, but he had "managed to keep going on light duty" for two months before he finally reported sick and came under my observation.

Such phenomena are especially apt to occur when to the effects of shock conditions of previous long-continued anxiety and nervous exhaustion are superadded. That is to say, they imply a certain instability of cerebral activity, and in this connexion it is noteworthy that the liability to mental confusion, inattention, fatigue and hallucination and the tendency to perseveration occurring in the above-mentioned cases, are the very symptoms observed by Head and Holmes (*op. cit.*) as the effects of cortical injuries.

BREATHING AND PHYSICAL EXERCISES FOR USE IN CASES OF WOUNDS IN THE PLEURA, LUNG AND DIAPHRAGM.[1]

By CORTLANDT MacMAHON, B.A.Oxon.

Instructor for Speech Defects at St. Bartholomew's Hospital, etc.

The exercises herein described have been used since the early months of the War on a large number of soldiers suffering from wounds of the pleura, lung and diaphragm, in St. Bartholomew's Hospital, Guy's Hospital, King Edward VII's Hospital for Officers, Princess Henry of Battenberg's Hospital for Officers, No. 1 Base Hospital, the Hospitals for Officers at 17, Park Lane and Dorchester House, Mrs. Hall Walker's and Mrs. Herbert Samuelson's Hospitals for Officers. The exercises are now set out in the hope they may be of general use in similar cases.[2]

The chief objects of the exercises are :—

(*a*) To prevent pleural adhesions forming and to break down existing adhesions by careful and gradual movements.

(*b*) To enable lungs, which have collapsed owing to pressure due to empyema, hæmothorax and pneumothorax, to regain their normal condition.

(*c*) To reduce hæmothorax and pneumothorax.

(*d*) To restore the normal shape of the chest walls which have fallen in owing to collapse of the lungs.

(*e*) To assist the discharge of pus, where there is a drained empyema, by increasing the lung inflation.

(*f*) To improve the general condition by the tonic effects of the exercises, and especially to overcome breathlessness on exertion.

The early exercises can be carried out without moving the patient from his bed. At first an operator is necessary, who should, if possible, give the exercises daily for about a fortnight, after which time the patient can perform most of them for himself, and they should then be carried out night and morning half an hour before a meal. Great care must be taken that there is no

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[1] See also the *Lancet*, October 2, October 9, December 4, 1915, and January 29, 1916, and the *Brit. Med. Journ.*, January 22, 1916.

[2] For a description of cases treated see paper by C. MacMahon in vol. xxxix of the *Proceedings of the Medical Society of London.*

exhaustion to the patient; only a few exercises should be given at each treatment, and after every six movements of each exercise a rest of at least two minutes should be given. It is advisable that only the first three movements of the exercises should be given for the first three days of the treatment, and, in a case of empyema that has recently undergone operation, the first four movements only should, as a rule, be given until the drainage-tube is removed, but when the temperature has remained normal for some days more extensive movements may be applied.

When the patient can be moved from bed the exercises should be carried out on a narrow couch or table. The free movement of the arms in all directions is essential. Special attention is called to the fact that all the exercises are carried out in a recumbent position, and that on the correct performance of the first three exercises depends the success of the others. Care must be taken that the upper chest is not drawn up nor the abdominal wall contracted during inspiration. These are the two great faults often found. Any protrusion of the abdominal wall during inspiration must also be guarded against. The time of commencement of the exercises, their extent and duration, are matters entirely for the physician or surgeon who has charge of the case. A marked improvement in the appetite, the sleeping, and the general appearance will, as a rule, be noticed within a week of the commencement of the treatment.

The exercises are as follows, it being clearly understood that only a few should be carried out at each treatment, and the advance through the exercises should be gradual and special exercises selected to suit the individual condition. Each particular exercise should be carried out eighteen times with a rest, as already stated, after each six movements of the exercise.

(1) The operator places his hands on the side of the lower ribs level with the breast-bone. The patient should breathe in through the nose and the lower ribs should be felt to be expanding strongly. There should be as little movement as possible of the upper chest. When the fullest inferior lateral costal expansion is acquired, the patient should breathe out through the open mouth and the ribs should be felt to regain their normal position.

(2) The abdominal wall should be contracted inwards and then allowed to recover its normal position, so that an in-and-out movement is made. (This is a physical and not a breathing exercise and can be carried out twenty to fifty times.)

(3) Combine the above movements, i.e., the patient breathes in through the nose and the lower ribs are felt to be strongly expanding. The mouth is opened wide and the abdominal muscles slowly and strongly contracted, so that the air is driven from the lungs.

(4) The same inspiratory movement, but the breath should be held and the abdominal muscles contracted in three to five deliberate movements before breathing out.

(5) Bend the body laterally away from the side of the injured lung to the fullest extent, so that the uninjured side of the thorax is partially compressed. The patient is on his back and the head and feet are drawn round as far as possible. The operator should press over the uninjured lung with both hands and the patient should breathe, as before, in through the nose and out through the mouth, contracting the abdominal muscles as he breathes out. (When there has been considerable collapse of the ribs on the side of the injured lung, and especially when there has been an abscess in the lung, great care must be taken in doing this movement, otherwise considerable muscular discomfort will occur within a few hours. A certain amount of pain will necessarily be felt if there has been a serious collapse in the chest wall, but this can, of course, be relieved.)

(6) The same movement and position, but the operator should press with his hands on the side of the uninjured lung with a pressure of thirty to sixty pounds and the patient should contract the abdominal wall, with the breath held, at first once, afterwards increasing by degrees to five times.

The following exercises are done with the breath held in :—

(7) Grasp the wrists of the patient as the arms lie at the side of the body, the operator standing behind the patient. Draw the arms outwards and upwards to above the head, pull on the arms steadily when the arms are at their fullest extent, then relax the pull. The patient should then breathe out quickly.

(8) Arms as before. Bring them together in front and carry upwards to a right angle. Part the arms strongly backwards and horizontally.

(9) The same exercise as the preceding one, but the arms are carried backwards at an angle of 45° upwards.

(10) Commence with the patient's arms above the head, with the palms of the hands facing each other. The operator grasps the arms between the wrists and the elbows and presses the arms strongly downwards, and when the elbows approach the sides the

abdominal muscles should contract. Force the elbows into the side and make the patient breathe out strongly.

(11) Grasp the right wrist of the patient with the left hand, carry the arm forwards, and bring it to a right angle with the body. The operator should then place his right hand well under the scapula of the patient and pull the arm backwards and downwards as the patient strongly contracts the abdominal wall. Changing the hands, do the same movement on the other arm of the patient.

(12) When there is marked collapse of one side of the upper chest the body should be bent as in Exercise 5, and the wrist of the arm on the wounded side grasped, the arm being fully extended above the head, the patient should then pull the arm downwards with the elbow into the side and should strongly contract the abdominal muscles as the arm descends. The operator gently pulls against the patient. (This exercise is exhausting unless carried out very carefully; six movements are sufficient during the first few applications of it.)

The earliest time at which the exercises have been commenced has been fifteen days after the insertion of the drainage-tube in cases of empyema and thirty-three days in cases of hæmothorax from the date of the wound.

Very great care must be taken that the instructions given above are carefully followed, otherwise harmful results might ensue.

When a patient suffering from the effects of a lung wound is convalescent, he should be encouraged to sleep on the side of the injured lung and when resting by day to adopt the body position described in Exercise 5. This will help recovery by enabling the injured lung to inflate more easily.

Clinical and other Notes.

A TABULAR STATEMENT OF FIVE HUNDRED ABDOMINAL GUNSHOT INJURIES.

By Temporary Colonel CUTHBERT WALLACE, C.M.G., F.R.C.S.
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In an article on the early operative treatment of wounds of the alimentary tract which appeared in the *Lancet*,[1] a promise was made to publish the results when a sufficient number had been collected.

The table has been compiled to show primarily the nature of the operation performed. Under the "remarks" column an attempt has been made to indicate to some extent the nature of the injury.

The cases from which the table is made comprise all the abdominal injuries from a certain sector of the line, which reached a Casualty Clearing Station or a Field Ambulance fitted for abdominal work. The period included both times of quiet and of strenuous fighting. The series may therefore be said to be a representative one.

The two abdominal hospitals were about 5,000 yards from the fighting line. At these arrived many cases which would never have reached a Casualty Clearing Station. This fact has raised the total mortality five per cent above that which it would have been, had the two abdominal hospitals been excluded.

It may seem paradoxical, but within limits, the nearer the surgeon gets to the firing line the worse will be his total mortality and perhaps even his operative mortality.

The main facts may be summarized as follows:—

Total number of cases	511	
Arrived moribund	145	
Total mortality excluding the moribund	45·8	per cent.
,, ,, including moribund	61·25	,,
Considered with view to operation	366	
No operation considered advisable	56	
Total operations	310	
,, operative mortality	53·9	per cent.
,, hollow viscera mortality	64·5	,,
Stomach mortality	43·75	,,
Small gut (uncomplicated) mortality	63·8	,,
Great gut (uncomplicated) mortality	60·0	,,

The following table (which is to be considered only approximately correct) gives the number of times that the different viscera were injured. The unoperated cases are not included.

[1] December 18, 1915.

	Alone of hollow viscera	With other hollow viscera	Total
Stomach	16	7	23
Small gut	69	21	90
Great gut	61	12	73
Liver	..	..	48
Spleen	..	..	11
Kidney	..	..	13
Bladder	..	..	13
Ureter	..	..	3
Pancreas	..	..	1

To the forty-eight cases another fifteen cases should be added in which the liver was almost certainly injured, but in which no operation was performed.

Small Gut.—Resection has a higher mortality than suture, but this is merely the result of the initial injury. The effect of increased injury is well seen in the rise of the mortality, whether after suture or resection, when other viscera are involved.

The actual junction line has rarely given trouble. There were three cases of obstruction due to non-toxic-paralysis. Suture is to be preferred to resection except when there is a distinct saving of time by the latter method. The unpaired edges heal well after suture—there seems no reason to fear sloughing on account of any commotion caused by the projectile.

A most striking thing about the soldier's small intestine is its emptiness—a great contrast to the loaded state of the great gut.

Stomach Wounds.—Of twenty-three stomach wounds only eleven were uncomplicated by other lesions. The anterior wall was most often involved. The "typical" anterior-posterior epigastric wound was not common. Extrusion of stomach contents was fairly frequent and depended on the time of the last meal.

Of the seven fatal cases uncomplicated by wounds of other hollow viscera, four died of the results of primary hæmorrhage. Reading the notes on the cases while making this table has impressed my mind with the seriousness of wounds in the epigastric region, and I am still inclined to advocate operation in all cases. Hæmorrhage is evidently to be feared here as in wounds in other regions.

The escape of the spleen in stomach injuries is so marked as to suggest that many such injuries never reach the surgeon.

Large Intestine.—The large intestine was injured a greater number of times than its bulk would lead one to expect. The mortality was about sixty per cent and largely caused by wounds necessitating the formation of an artificial anus. The actual cause of death was either peritonitis or perhaps more frequently septic infiltration of the retro-peritoneal tissue. There are not enough cases from which to draw a deduction as to the comparative fatality of wounds of different parts.

TABLE I.

Operation or injury	Base	Died	Remarks
Suture of stomach	9	7	Anterior wall, 8; anterior and posterior wall, 5; near œsophagus, 1; great curvature, 1; cardiac, 1; serous and muscular coats only, 1. Fatal cases: peritonitis, 1; primary hæmorrhage, 4; unnoted wound near œsophagus, 1; gas gangrene, 1.
,, ,, and small gut.. ..	—	2	Lesions in small gut, 3-5; anterior and posterior walls, 1; double perforation anterior wall, 1.
,, ,, resection of small gut; gastro-jejunostomy	—	2	—
Suture of stomach; resection of small gut; gastro-jejunostomy; artificial colon anus	—	1	Lateral anastomosis of small gut, 5; lesions of small gut, stomach divided, transverse colon divided.
Suture of stomach; artificial colon anus ..	—	1	Anterior and posterior wounds of stomach.
Suture of stomach and small gut; gastro-jejunostomy	—	1	Duodenum torn, 3; penetrations of anterior stomach wall, liver and kidney ruptured, 1.
Resection of small gut; circular enterorrhaphy	11	33	Number of lesions M, M, 6. 4, 3, M, 3, 7, 8, 6, 3, 3, 9, 12, 5, 4, 1, 6, 9, 1, 4, 4, 5, M, M, 3, M, 4, 2, 15, M, M, M, 1, 5, 2, 4, 7, 9. Inches resected 8, 4, 48. 72, 24, 6, 36, 18, 30, 6, 24, 108, 48, 48, 4, 18, 24, 32, 12, 18, 24, 26, 36, 36, 36, 30, 24, 15, 6, 24, 18, 18, 10, 12, 6, 30, 18, 3, 23. Secondary short circuit for obstruction, fatal, 2; double resection, fatal, 4; gangrene of thigh, fatal, 1; bladder also wounded, 3; iliac vein, torn also, 1; serous coat of cœliac sutured also, 1
Resection of small gut; lateral suture ..	2	5	Lesions: M, 6, 8, 8, 4, 12, 3; inches resected: 144, 12, 96, 4; to transverse colon, 1; to ascending colon, 1; double resection, fatal, 1; ureter wounded, recovered, 1.
,, ,, artificial colon anus	1	4	Lesions: M, 6, 3, 8, ; inches resected 114, 12, 12; pelvic colon, 2; transverse colon, 1.
,, ,, suture of colon ..	-	3	Fourteen lesions in small gut and 4 in colon, 1; 8 in small gut and multiple in colon, 1.
,, ,, ,, cæcum ..	—	1	—
,, ,, ,, rectum ..	—	2	Lesions in small gut, 7; 18 inches resected, 1.
Suture of small gut	14	11	Number of lesions 3. 1, 1, 5, 5, M, 3, 2, 3, 2, 2, 1, 5, 1, 1, 1, 1, 3, 2, 7, 1; duodenum, fatal, 2; large prolapse of intestine, 2; secondary short circuit; recovered, 1.
,, ,, suture of colon ..	—	3	Hepatic flexure, 1; transverse and descending colon, 1; transverse colon, 1.
,, ,, ,, cæcum ..	—	1	—
Small gut anus	—	4	—
For small gut fistula	2	1	Opening external wound.
Suture of small gut; artificial colon anus..	1	—	,, pelvic colon.
Suture of cæcum	4	—	—
Cæcal anus	2	3	—

Suture of colon	11	13	Ureter also injured, 2; both pelvic colon cases; spleen and liver ruptured, fatal, 1.
Artificial colon anus	6	17	Ascending, 6; hepatic, 5; splenic, 3; iliac, 1; pelvic, 5; descending, 2; spleen and kidney removed, fatal, 1; iliac vein torn, 1.
Proximal colostomy	2	3	For wounded rectum, 4; splenic flexure wounded, 1; spleen perforated, fatal, 1; bladder wounded also, 1.
Cœliotomy; no hollow viscus perforated ..	28	11	Bleeding point found, 9; colon bruised, 8; fatal cases: paraplegia, 1; continued hæmorrhage, 1; iliac vein torn, 2; vena cava torn and ligated, 1; extensive recto-peritoneal hæmorrhage, 1; marked intestinal distension, 1; gas gangrene, 1.
Prolapse of viscera	6	3	Stomach and colon, 2; stomach, spleen, colon and small gut, 1; small gut, 1; colon, 4.
Loss of abdominal wall	—	1	Stomach exposed.
Contusion of abdomen	—	2	By shell fuse, jejunum ruptured, resection, 1; bladder, 1.
Tube to pelvis	—	2	Too bad for further exploration.
For fæcal abscess	1	6	Intraperitoneal.
Drainage of loin wound	1	1	—
For wounded liver	31	11	Fatal cases: gas infection, 1; multiple body injuries, 1; kidney also injured, 2; recto-peritoneal, 1; biliary empyema, 1; jaundice, 5; bile in peritoneum, 1; cystic duct torn, 1.
Pancreas, exploration of..	—	1	In course of exploratory cœliotomy.
Kidney, excision of	—	—	See "Splenectomy," 2.
,, exploration of	1	—	Peritoneal toilet. See also liver, 2; and suture of stomach, 2.
,, wounded	—	—	See "No operation," 4.
,, loin, exploration of	1	—	—
Spleen, excision of	1	4	Kidney removed also, 2. See also "Colon, artifical anus," fatal, 1.
,, suture or packing of	2	—	Stomach bruised also, 1.
,, exploration of	—	1	Death from hæmorrhage. See also "Proximal colostomy."
Bladder, suture of	2	—	—
,, suprapubic; drainage of ..	4	6	See also "Proximal colostomy" and "Resection of small gut," 3; iliac vein torn, fatal, 1.
Ureter, wound of	—	—	See "Resection of small gut and lateral suture," 1; and suture of pelvic colon, 2.
No operation; absence of indication ..	55	1	Liver probably wounded, 15; kidney wounded, 4; omentum prolapse, 3; fatal case developed hæmothorax and septicæmica.
,, (moribund)	—	145	Post-mortem when performed showed following lesions: Multiple lesions of small gut, 15: stomach and liver, 1; spleen, stomach, pancreas and liver, 1: ruptured spleen, 1; colon wounded, 4; rectum, 1; liver, 1; internal iliac vein, 1; bladder also wounded, 2.
	198	313	
	511		

Note: M = multiple injuries.

Wounds of the transverse colon are more apt to be multiple than those of the other parts.

Considering the extent of the injury, the wounds of the great gut are much more fatal than those of the small gut—no doubt due to the greater toxicity of the great gut contents.

Liver.—Most of the injuries were explored on account of hæmorrhage or doubt as to the involvement of hollow viscera. Hæmorrhage usually ceases in a few hours unless a vein in the liver substance has been opened, when the bleeding is continuous and dangerous. A good many cases might have got well without operation.

Spleen.—There is good reason to think that a good many spleen cases get well of themselves, and that it is only when the vessels are torn that the bleeding is excessive.

The kidney and spleen seem to be not uncommonly injured together, while the stomach which lies so near escapes.

TESTS FOR SIMULATED DEFECTIVE VISION OR FOR BLINDNESS OF ONE EYE.

By Temporary Lieutenant-Colonel Sir JOHN COLLIE, M.D.

These instructions are intended for the use of medical examiners, other than ophthalmic experts.

It is hoped that by a selection from the experiments here suggested the less skilful attempts at deception may forthwith be frustrated, and the recruit be induced to read up to the required standard, otherwise he should be referred for the ophthalmic examination of the expert, because what appears to be an attempted fraud may only be an exaggeration of genuine defective vision.

Many men who complain of defective vision do not persist in their complaint when they appreciate that they are being examined in a way which will probably lead to detection, and it is believed that in many cases only one of the following tests may be necessary.

The experiments are arranged in the order of their simplicity and their applicability to the examination of recruits.

The apparatus required for the various tests is of a very simple and inexpensive nature. A list of the things required for the tests is subjoined.

It is assumed in all these experiments that care is taken that the patient does not succeed under any pretext in closing either eye momentarily.

Recruits sometimes get to know before examination what the letters in the different lines of Snellen's test cards are. Those who have defective vision and wish to pass sometimes affect to read the first

three lines when they do not in fact see them. A fixed transposition of the lines becomes known. A useful plan is to have each line of Snellen's test types printed on a separate slip of cardboard: these can be arranged in various positions on a frame by a simple arrangement of slots.

Tests for Simulated Partial Blindness.

(1) This test may be used for the discovery of a fraudulent allegation of defective vision in one eye, short of simulated blindness.

It depends upon two facts: First, if both eyes are open, it is impossible to tell with which one sees an object, and second, anything coloured red cannot be distinguished as red if seen through a red glass by *reflected* light. If, for instance, half of the letter W is printed in red and half in black, it will be read as V through a red glass.

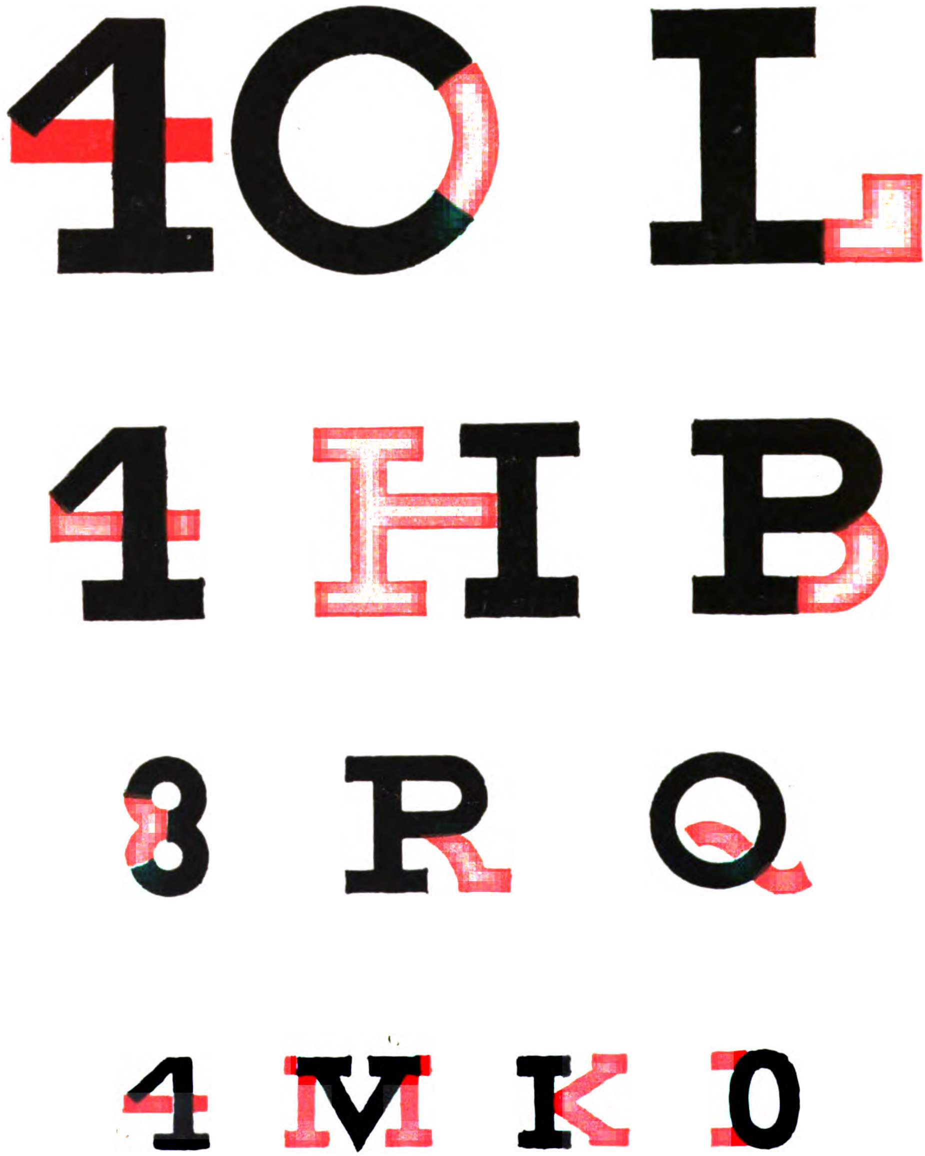
The following procedure is suggested:—

The recruit should first be tested in the ordinary way by Snellen's test types, and the visual acuity noted. Suppose he reads $\frac{6}{6}$ with the left and $\frac{6}{36}$ with the right eye. He should then be brought two feet nearer the test type, his back momentarily turned, and the card with parti-coloured letters substituted for that of Snellen. This test should not be applied in a very bright light (either day or artificial). He is fitted with a trial spectacle frame with a red glass for one eye and green glass for the other, the green glass in this case being placed in front of the right eye and the red glass in front of the sound (left) eye. He is *then* told to turn round and read with both eyes off-hand as far down the card as he can, commencing at the largest letter. If he now reads the red portions of letters of any line below $\frac{6}{36}$ he is, of course, doing so with the eye he alleged to be defective, and the lower down he reads the better he proves the vision in his right eye to be. For instance, if he reads 40 as 40 and not as 1 C, and L as L and not as I (see letters on next page), he must have read these with his right eye, as the red portions of these letters were invisible to the left eye.

When the card has been once seen by the recruit he must *never* be allowed to look at it again without the coloured lenses in front of his eyes. If this is permitted, even momentarily, the whole procedure will be unsuccessful. When made to face the card it should be insisted that he reads the table at once, otherwise he may observe a lustre in the red portions, which would arouse his suspicion. (Haselberg.)

(2) If it is suspected that an alleged inability to read anything but the large letters of Snellen's test types is not genuine, the following experiment is helpful:—

The recruit is placed twenty feet away from a looking-glass, in front of which is placed a card with Snellen's test types. He is instructed to indicate the line beyond which he can no longer read the letters.


40 L
4 H I B
8 R Q
4 M K 0

The card is removed from the mirror, and he is told to stand ten feet nearer the mirror. A test-type card with letters of the same size, but printed *backwards*, is placed in his hands and held in front of his chest as he faces the glass. He is now told to read the letters which he sees reflected on the mirror. As he is now standing at half the distance from the mirror that he was in the first place (should he be ignorant of the laws of reflection) he may be induced to read double the number of lines he read in the first instance.

(3) Simulated defective vision may be demonstrated as follows:—

Render the sound eye artificially myopic by placing in front of it a convex glass of 5D. Assuming the eye is emmetropic, its far point is now about twenty centimetres (eight inches) distant, and with this eye he cannot read fine print farther away. He is asked at first to read with both eyes at quite a short distance, and now if the print is gradually withdrawn considerably farther than twenty centimetres, and he continues to read aloud, it is apparent that he is now reading with the alleged defective eye, which he brought into use when the artificially myopic one was put out of range by the withdrawal of the book. (Duane.)

(4) The same test may be applied for distant vision, as follows:—

The patient is placed twenty feet from Snellen's test-types. A trial frame is used containing a plain glass in front of the eye said to be blind or defective, and a convex 8D. in front of the sound eye. He is at once urged to read with both eyes. If he succeeds in doing so it is with the eye which has been declared to be defective.

Before putting the strong convex lens in front of the sound eye it is well first to disarm suspicion by placing a series of very weak concave lenses in front of the eye.

(5) Whilst the recruit is reading aloud, a prism of 4° with its base downwards is placed in front of the alleged defective eye. If the vision in that eye is really poor, the presence of the prism will make little or no difference, and he will read on as before. On the other hand, if he sees fairly well with this eye, the presence of the prism will produce superimposed double images, consequent confusion, and an involuntary pause in his reading. (Duane.)

(6) Bishop Harman's Diaphragm Test consists of a flat ruler eighteen inches long. At one end is a piece of wood called the carrier, set at right angles, on which is placed a small card with letters or numbers. Five inches from the carrier there is a small vertical screen, which is pierced by a hole three-quarters of an inch in diameter. The apparatus is used by placing the end opposite the carrier immediately below the nose, on the upper lip, asking the recruit to read the letters through the hole inthe screen. The application of the test depends on two facts:—

(*a*) That one cannot perceive with which of his two eyes he is seeing if both eyes are kept open.

(*b*) That objects on the right-hand side are seen by the left eye, and those on the left by the right eye.

A small card with the following letters or numbers

A B C D E F G

is placed upon the carrier, and the recruit is instructed to read through the hole. If the recruit only reads D E F G, it is obvious that his right eye is defective; whereas if he only reads A B C D, it is equally clear that he is only using his right eye, and his left eye is defective, for, as is well known, the visual axes cross. It is impossible for a malingerer, if he does not understand the instrument, to succeed in pitting his wits against those of the medical examiner.

The visual acuity may be tested by letters of different sizes.

The possibility of the fraudulent use of atropine has to be borne in mind. Where the pupil is widely dilated and fixed and conjunctival injection is present, the condition is suggestive of the recent use of a mydriatic. The astute malingerer, however, applies atropine a day or two before the examination, when the pupil will be sluggish and only partially dilated.

Tests for Simulated Total Blindness of One Eye.

Alleged Blind Eyes.—An eye which deviates on fixation of the other eye is generally blind. A fixed dilated pupil (apart from the use of atropine) suggests organic rather than functional blindness. A pupil which remains motionless when exposed to bright light, but contracts under the influence of convergence and accommodation, points to the probability of unilateral blindness.

(7) Haselberg's test (No. 1) may be used for demonstrating simulation of total blindness.

(8) The recruit's name should be incorrectly spelt with a red crayon on white paper, the pencil being pressed lightly on the paper. A trial spectacle frame is put on the face; it should have a green eye-piece in front of the alleged blind eye and a red eye-piece in front of the sound eye.

The recruit is then asked if his name has been spelt correctly. If he says anything but that he can see no writing it is obvious that he is attempting to deceive, because red letters on a white opaque ground when viewed by *reflected* light cannot be seen through a red glass, since they offer no contrast to the background.

(9) Print on a piece of ordinary notepaper the letters R E S O R T. The letters should be made alternately with a very soft red crayon and a soft black pencil. If it is alleged that the right eye is blind, a piece of red glass is placed in front of the left eye and the patient is asked, not to read the word, but to *spell* the letters in front of him. If he spells R E S O R T then he sees with the right or alleged blind eye. The red glass prevents the red letters being seen with the left eye, and as he *has* read the red letters, he must have done so with the right eye. It is important not to mark the letters heavily, or the impression of the letters, apart from colour, will be left on the paper and can be read; hence the recommendation to use a soft pencil; red ink is not suitable.

(10) A recruit is asked to read simple small printed words from a book. Suddenly, whilst he reads, a pencil is placed vertically in the middle of the page of print, or three or four inches in front of it. If he sees with both eyes, he can read straight on, for he can see round the pencil as it were—he really reads on each side of it. If one eye is blind he stops, for one or two words are hidden by the pencil. (Javal—Cuignet.)

(11) Alleged total blindness of one eye is readily demonstrated by directing the recruit to read by *transmitted* light the letters of the word T H E O R Y made of transparent glass on an opaque ground. The letters are of red and green glass, and placed alternately. Assuming that the right eye is stated to be blind, before being asked to *spell* out the word a spectacle frame is placed on the face, with a red glass in front of the left eye and a green glass in front of the right eye. By *transmitted* light through the red glass of the spectacles the red letters only are seen, and through the green glass the green letters only are seen. If, therefore, the recruit reads the whole word he has read the green letters with his right eye which he stated was blind.

(12) With monocular vision stereoscopic vision is lost. By means of an ordinary stereoscope it may be demonstrated whether a patient is using one or both eyes. Most of the ordinary double photographs prepared for the stereoscope have a description of the subject printed at the bottom of one photo only—generally that opposite the right eye. This printed matter, when looked at through the stereoscope, is seen with the right only, and if, therefore, it is read, it proves that the right eye is not blind.

Now, if the printed matter is covered over by means of a strip of paper, and the same or other words are written at the bottom of the photograph which is opposite the left eye, and the patient again reads the description, he sees also with his left eye.

A special stereoscopic picture has been prepared. Opposite the right eye there is a picture of a boy, and opposite the left that of a man. These viewed through the stereoscope are seen separately if the eyes are closed alternately, but if looked at with both eyes the boy is seen on the man's back. The opportunity of catching out a malingerer with this device is obvious.

(13) Tests for binocular vision in alleged monocular blindness:—

(*a*) Place a lighted candle in front of the subject; hold an 8° prism base outwards before one eye. If both eyes see, the one behind the prism will move inwards, and on removing the prism will move outwards; the other eye remains fixed. (Welz.)

(*b*) A lighted candle is placed twenty feet from the subject; an 8° prism is put before the sound eye. If the superimposed double images are admitted, the fraud is apparent. In obtaining the admission it should not be asked if he sees two images, which gives an opportunity for a negative reply, but he should be requested to state at once if the two images are placed one above the other or side by side, and which is the brighter.

In neither (*a*) nor (*b*) need the room be darkened, although artificial light is being used.

Apparatus required for the Tests.

Trial spectacle frame with: A plain glass; a red glass; a green glass; two convex lenses, one 5D. and the other 8D.; two prisms, one 4° and the other 8°. Snellen's test-types reversed. Soft red crayon. Bishop Harman's diaphragm test. Mirror. Haselberg's parti-coloured test-card.

CASE OF ACUTE YELLOW ATROPHY OF THE LIVER TREATED BY INJECTIONS OF SODIUM BICARBONATE; RECOVERY.

By Temporary Captain C. NEPEAN LONGRIDGE.
Royal Army Medical Corps.

E. P., aged 25, reported sick on October 1, his symptoms at that time being headache, pains in the legs, occasional slight attacks of diarrhœa, and a pain described as neuralgic in character in the gums. These symptoms were accompanied by fever. He was sent from Gallipoli and admitted to the Giza Hospital, Egypt, on October 10, 1915. Inquiry into his previous history revealed nothing of any interest except an attack of synovitis of the knee some years previously. On admission he complained of feeling sick, loss of appetite and feeling weak, the pains in his legs being much better. He was a healthy-looking, fresh-complexioned young man and well nourished. The tongue was

clean, teeth good, and there was a slight tinge of jaundice in both conjunctivæ. The bowels were acting normally, temperature 99·6° F., and pulse normal.

The case was regarded and treated as one of epidemic catarrhal jaundice which was common at the time.

On October 13 marked icterus had developed, the water was mahogany-coloured and the stools like clay; temperature normal, liver dullness normal. The following morning he had a severe fainting attack for no ascertainable cause, and complained of pain in the epigastrium. He vomited occasionally and was obviously ill; the jaundice had increased and the liver dullness was found to extend from fifth space in nipple line to just below the costal arch. He was ordered a drachm of glucose in five ounces of water every four hours by the rectum, and a drachm of sodium bicarbonate in two ounces of water every two hours by the mouth. A specimen of water was examined and found to contain large quantities of leucin and tyrosin. The temperature was subnormal and the pulse 70, of good quality.

On October 15 the patient was no better. He had continued to vomit bilious fluid, the bowels had acted and the motions contained a small quantity of blood; the tongue was clean, but the man was violently delirious, and the liver dullness had descended to the sixth space in the nipple line. The injections of glucose into the rectum were continued with difficulty and could not be given regularly. The sodium bicarbonate was now administered hypodermically, 100 cubic centimetres of a two per cent solution being injected morning and evening.

The delirium continued throughout the night and the next day; there was incontinence of urine and fæces, some blood was noticed in the vomit, which was now less frequent. The jaundice was no deeper, the pulse 60, of fair quality, the liver dullness had descended a further half an inch. No petechiæ were visible on the skin. Only a few ounces of very dark urine were passed. The injections of sodium bicarbonate were continued to the exclusion of everything else. He could only be persuaded to take a few mouthfuls of milk or lemonade occasionally. At this period, Colonel William Hunter came over from Alexandria to see the man, and agreed that it was a case of acute yellow atrophy of the liver in all probability, and recommended continuation of the same treatment. On the following morning (October 17) the patient was conscious and had slept a few hours, the pulse improved and the liver dullness had gone up half an inch to the sixth space. Over 200 cubic centimetres of alkaline urine were passed, still containing leucin and tyrosin, but neither albumin nor sugar. The improvement continued on the 18th, the liver now reaching the fifth space, and within a few more days the patient was convalescent and the liver was found at the upper border of the fifth rib. On October 21, with the exception of occasional attacks of nausea, the patient made an

uninterrupted recovery and left the hospital for the Luxor Convalescent Home on November 18

I record this case because, in the opinion of Colonel Hunter and Major Llewellyn Phillips, who also saw the case, it was one of acute yellow atrophy, and the injections of sodium bicarbonate were the probable cause of the favourable termination.

The atrophy is an acute autolytic degeneration of the liver, a process which is much more rapid in an acid than in an alkaline medium, and therefore demands a free administration of alkali to bring about its arrest. It is closely akin to what occurs in certain cases of eclampsia, in which I believe I was the first to point out a marked diminution of the alkalinity of the blood (estimated by Wright's method). In these cases of eclampsia I have learnt to regard as an ominous symptom complaint of pain in the epigastrium, such as this patient had.

A SANITARY LAUNDRY ON THE LINES OF COMMUNICATION.

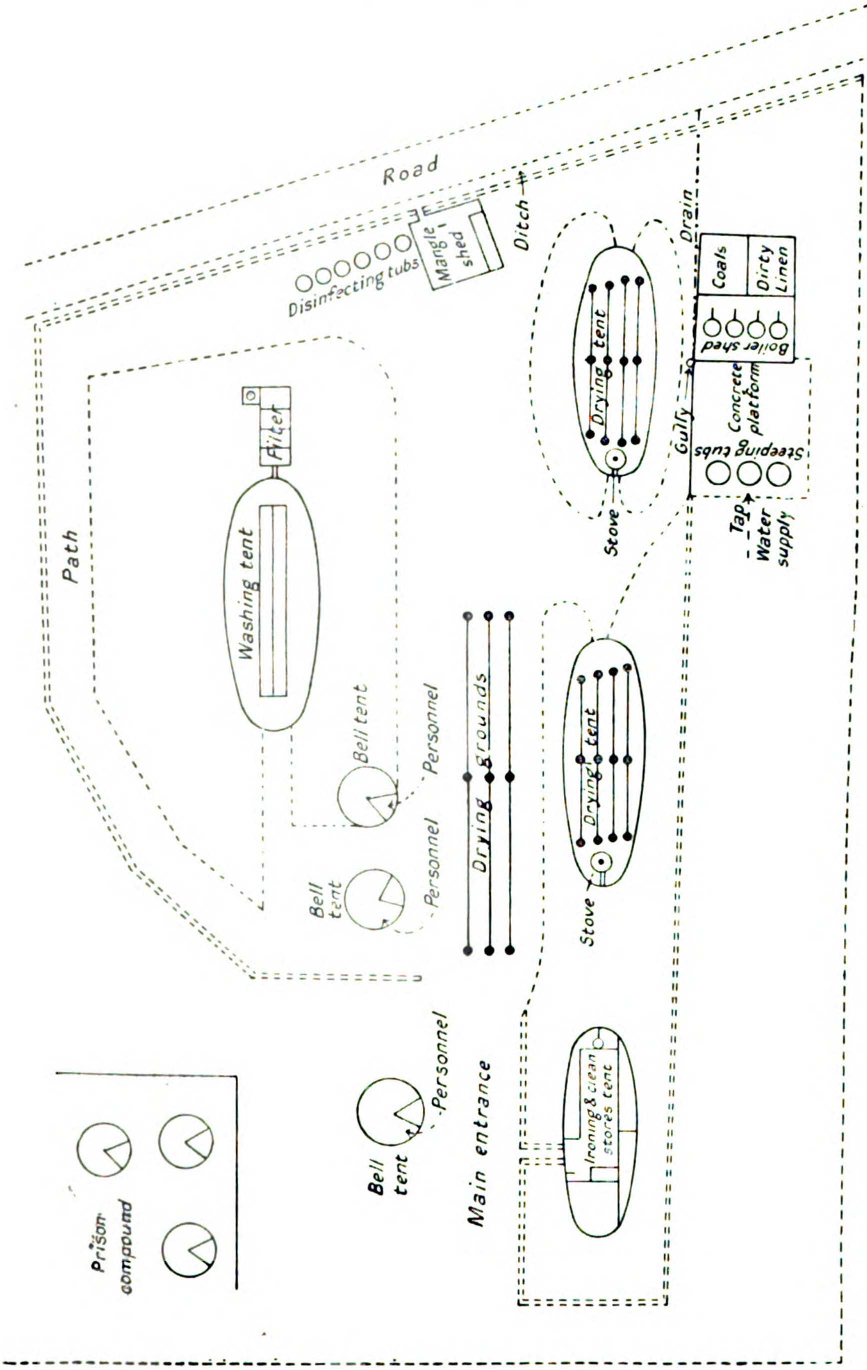
By Serjeant-Major E. B. DEWBERRY.

Royal Army Medical Corps.

During the early period of the War when reinforcements were being rapidly sent up from the base camps in France to the front, it was found that a quantity of dirty though serviceable clothing, underclothing, socks and other articles were thrown away by the troops waiting in camps and under orders to entrain. This wastage was practically unavoidable in the earlier stages of the campaign owing to the unusual conditions obtaining at the time. The various articles were generally left scattered in the neighbourhood of the tents, and being collected by the men on sanitary duties were mixed with the other camp refuse, and ultimately found their way to the incinerators. The clothing was very dirty and probably infested with lice, and as the troops had neither the time nor the convenience for washing it, the only course which appeared open to them was to throw it away. Various attempts were made on a small scale to stop the wastage, but they did not meet with any great measure of success.

In the month of June, 1915, it was definitely decided to try and remedy this state of affairs, by arranging for each camp to collect the discarded articles, to sort out those which could be re-issued if washed, and to send the remainder, after having been torn into rags and disinfected, to the Ordnance stores. Orders were issued accordingly to the effect that on no account was any clothing or rags to be burned, but that they were to be dealt with as described.

Arrangements were then proceeded with for the erection of a small laundry to deal with the serviceable articles. Some difficulty was at



Block plan of "Sanitary Laundry." Double interrupted line denotes wood fencing; single interrupted line denotes stone edging.

first experienced in obtaining a suitable site where adequate drainage could be provided. This was owing to the nature of the ground, which before the War was ordinary cultivated land. Eventually this obstacle was overcome and a site was chosen close to the field punishment compound. The position was convenient on account of the fact that it was intended to have the washing done by the men undergoing No. 2 field punishment, and it also had the advantage of draining into a natural field drain.

A non-commissioned officer (Corporal) from the men receiving instruction in sanitary duties was put in charge, and another man was given the work of ironing and folding the clothes. The prisoners engaged in the washing and mangling operations were provided with canvas clothing to protect their Service dress, and were under the immediate supervision of a warder so as to ensue proper discipline.

In addition to ordinary articles of clothing, it was found possible to deal with the canvas clothing worn by the cooks employed in the cookhouses of the various base depots, and also the dungaree clothing worn by the man working on the Horsfall destructors burning excreta aud other refuse.

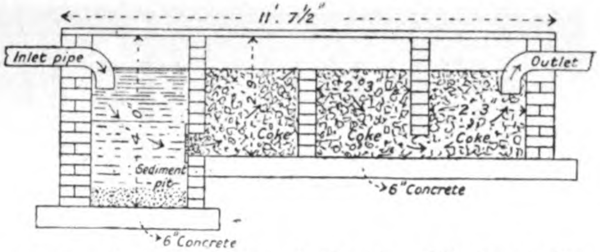
Drying Tents.—Two store tents were pitched, clothes-lines and pegs provided, and the tents were heated by stoves during inclement weather.

Boiler-house and Mangle Shed.—Two small wooden sheds were erected with drained concrete floors. One was used for a boiler-house in which five Soyer's stoves were provided for heating the water required. In front of this shed a concrete platform was laid down, on which were placed large wooden tubs with covers. Some of these tubs were used for soaking the clothes whilst others were filled with a solution of formaldehyde (strength eight ounces to the gallon), for steeping those articles which contained lice—the articles being left in the solution for twenty-four hours. The formaldehyde solution was used in preference to cresol solution as it did not stain the clothing. In the second shed was placed the mangle, with footboards for the men to stand on. The erecting of the sheds and the concreting of the floors were carried out by the men of the P. B. sanitary section.

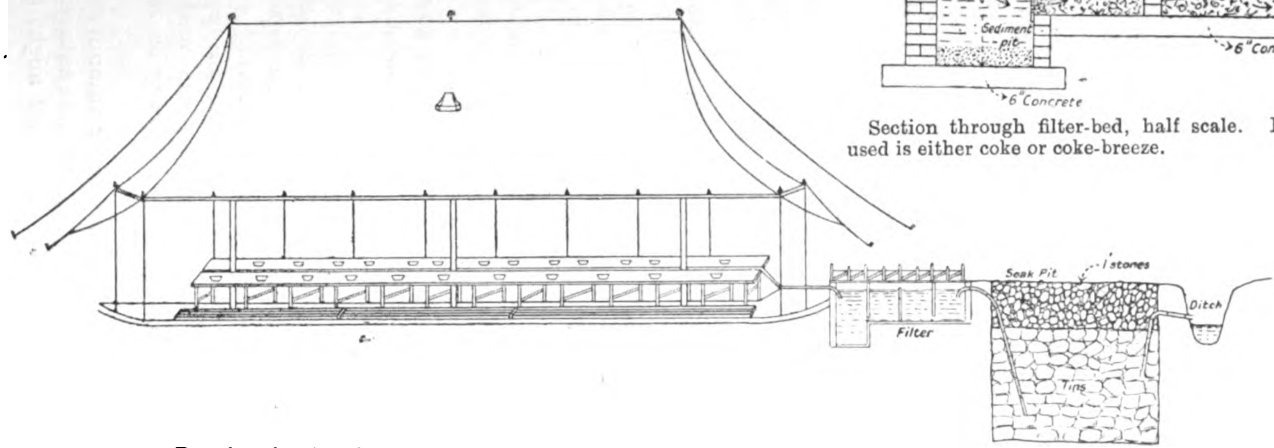
Drying in the Open Air.—Drying lines were also erected in the laundry compound for use in favourable weather. This outdoor method of drying and bleaching was used whenever the weather permitted.

Washing Tent.—The tent in which all the washing took place was provided with a concrete floor, with channels running from the centre to another channel on the outer edge so as to convey any spillage to the filter as shown in the sketch. The concrete floor proved to be preferable to one made of wood, but wooden footboards were provided for the men to stand on.

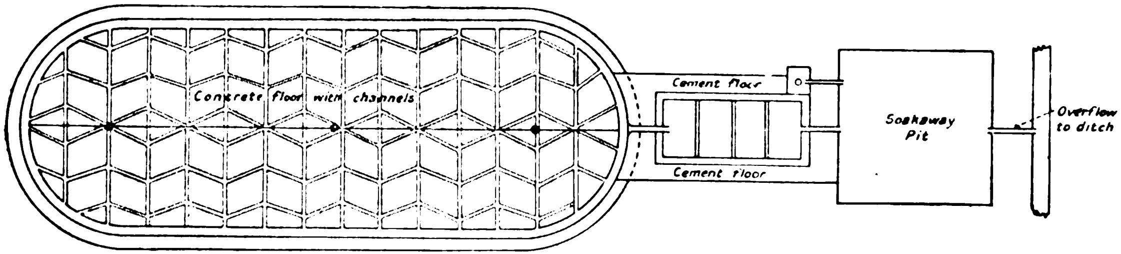
Wash-bench.—The wash-bench erected had accommodation for twelve



Section through filter-bed, half scale. Filtering medium used is either coke or coke-breeze.



Drawing showing the interior of washing marquee and section through filter-bed and soakaway pit.



Plan of washing marquee and filter-bed, with soakaway pit and overflow to ditch.

men on each side, and a channel running down the centre to carry off the waste, the whole bench having a slight fall towards the filter. The dirty soapy water after passing down the channel was carried through another channel in the floor to a pipe leading to the sedimentation pit.

Sedimentation Tank and Filter.—The working of the sedimentation pit, filter and sump is shown in the illustration. The effluent after passing through the filter, which was filled with coke, flowed into a straining and soak pit, and thence through an overflow into the field drain.

The sedimentation pit was thoroughly cleaned out once a week. This was necessary, as owing to the sandy nature of the soil a considerable amount of dirt and grit was carried in on the boots of the prisoners working in the tent, and being washed down the channel found its way into the pit. The scum on the water was cleared off once daily.

The above method of treating the dirty and soapy water by means of sedimentation and filtration through coke works remarkably well considering the large amount of waste water dealt with.

The laundry compound was closed by means of a low wooden fence periodically limewashed. The ground was drained and covered with clean gravel and paths were formed with large limewashed stones. Everything, of course, was kept as clean as possible.

Water Supply.—Some difficulty was experienced at the commencement of the work in obtaining a sufficient supply of water for all purposes and it had to be brought to the laundry in a water-cart and stored in tubs. Later, however, the water was carried through pipes to a stand-pipe in front of the boiler-shed. Pails were provided for the prisoners to transfer the hot water from the boilers to the washing tubs.

The following is a short summary of the procedure adopted in connection with the working of the laundry. A circular was issued to the various base depots, of which the following is an extract:—

"It is notified for information that the sanitary laundry is now ready to undertake the washing of any discarded articles of underclothing, Service dress, etc., (see Camp Order No. —, dated —).

"The chief object of this laundry is to enable all serviceable clothing, which is so frequently thrown away by soldiers on their departure to the Front, to be disinfected, washed, and re-issued to the depot from which it was received. In this way a considerable saving of good clothing is effected, which would otherwise be burned in the camp destructor. Arrangements have also been made for the washing of cooks' and dungaree clothing; these articles can generally be returned forty-eight hours after receipt."

Application was then made by the base depots for authority to send serviceable articles to the laundry to be washed, and this authority was forwarded with the articles. The articles to be washed might include

suits of Service dress, great-coats, kilts, underclothing, necessaries, canvas clothing, dungarees, etc. On arrival at the laundry the articles were sorted out and counted in the presence of the non-commissioned officer from the unit concerned, and any found not worth the cost of washing were returned to him. Army Book 182, was completed as carried out in the pack stores in hospitals, the counterfoil being handed back to the non-commissioned officer.

A copy of the instructions for the non-commissioned officer in charge of the laundry is given.

Duties of the Non-Commissioned Officer in Charge of the Sanitary Laundry.

(1) He will see that the Laundry and its vicinity is kept in a satisfactory sanitary condition at all times.

(2) He will carefully check the number of articles sent to be washed, in the presence of the non-commissioned officer concerned, and hand to him the counterfoil of Army Book 182, duly signed by himself and endorsed by the non-commissioned officer; at the same time taking particular notice of the condition of the articles, rejecting those which are not worth the cost of washing, and handing the latter back to the non-commissioned officer.

(3) He will keep in Army Book 129 (provided for the purpose) a daily record of all articles sent to be washed and stating from whence they came.

(4) When the clean washing is returned to the base depôts, he will obtain the signature of the non-commissioned officer removing them, as a receipt, afterwards filing the counterfoils for future reference.

(5) He will be responsible for all clothing whilst it is at the laundry, and that it is properly disinfected, washed, and ironed. Any deficiencies will be at once reported to the sanitary office.

(6) He will report any irregular conduct on the part of prisoners employed at the laundry to the warder in charge of them.

(7) He will see that a sufficiency of soap and other articles necessary for the satisfactory washing of the clothes are provided.

(8) He will report any complaints concerning the clean washing to the sanitary office.

(9) He will cause Army Book 129—with duplicate copy of weekly summary—to be rendered to the sanitary office every Saturday by 5.15 p.m.

The actual process of washing, soaking, and disinfecting the clothes varied according to the nature of the articles and their condition. The clothes sent to the laundry were usually disinfected by steam before they were forwarded, but as a precautionary measure they were treated with formaldehyde. Considerable difficulty was experienced in dealing with

the eggs of lice, especially in the folds of kilts, but this trouble was generally got over by the exercise of great care.

Cooks' canvas clothing was soaked in hot water containing soda in order to remove as much grease as possible. At times these articles had to be boiled, and especially dungaree clothing used by men on Horsfall destructors. The articles were then scrubbed with soap in the washing tent. It was found that fifteen pounds of soap were required for one hundred articles of the average size of a shirt. The articles were then mangled and dried; after being ironed with irons heated by means of Primus stoves and folded they were placed in racks by the store marquee, the rack being labelled with the name of the division to which they belonged. They were then ready for re-issue on the presentation of the counterfoil from the base depot.

Any mending required was carried out by the tailors in the base depots. It will be seen that in this way a great saving of serviceable clothing and necessaries was ensured, and as soon as this was realized by the various units the amount of clothing sent to the laundry increased. A daily record of all work done was compiled by the non-commissioned officer in charge (in Army Book 129), and a weekly statement made out. The following Table shows the number of articles washed, from June 21, 1915, to December 4, 1915.

Week ending	Number of articles washed
June 26, 1915	193
July 3, ,,	576
,, 10, ,,	429
,, 16, ,,	816
,, 25, ,,	575
,, 31, ,,	73
August 7, ,,	249
,, 14, ,,	594
,, 21, ,,	479
,, 28, ,,	760
Sept. 4, ,,	701
,, 11, ,,	966
,, 18, ,,	823
,, 25, ,,	522
Oct. 2, ,,	680
,, 9, ,,	493
,, 16, ,,	346
,, 23, ,,	643
,, 30, ,,	515
Nov. 6, ,,	745
,, 13, ,,	655
,, 20, ,,	735
,, 27, ,,	817
Dec. 4, ,,	787
Total	14,172

It might be added that no "coal" was allowed for this laundry, and the various base depots generously sent coal or coke for the purpose of heating the water for washing the clothes, as it was unsatisfactory to all

concerned for these to be washed in cold water. One bag of coal was found to be sufficient for a hundred articles of the size of a shirt. Soap and soda were supplied from the Ordnance stores.

A GIANT DISINFECTOR.

By Lieutenant-Colonel G. N. STEPHEN.
Royal Army Medical Corps.

In a war when everything is on so large a scale one's perception perhaps gets a little blunted. Otherwise I suppose I should have already mentioned a super-dreadnought in the way of mobile disinfectors that is at work out here. It is some months since I first saw a specimen, but only recently that I realized its strong points. These are durability in use, the effectiveness with which it does its work and the amount of this that it is capable of completing within a relatively short time.

In its general appearance it recalls a brewer's dray carrying two extra large barrels. The dray is a flat-topped motor lorry whose chassis is supplied not with a petrol, but a steam-driven engine. The two hogsheads or barrels are the bodies of twin disinfectors built upon the Thresh principle and capable of being used either separately or simultaneously. They are connected by piping with the engine of the lorry; so to set them in action all that is necessary is to cut off the steam from the driving cylinders, and turn them into the jackets of the disinfecting chambers. Consequently the disinfector is ready for action the moment a journey has been completed, and of course can be left standing, but still in use for an unlimited time at any place to which it has been brought.

In regard to its size, the chamber of each twin has a capacity of sixty cubic feet. The joint capacity is therefore nearly three times that of an ordinary mobile Thresh, such as has for long been more or less familiar in sanitary work in Great Britain.

The construction, however, of this giant which is capable of dealing with the whole of the blankets of a battalion within a limit of two ordinary working days—was originally due I understand, less to a desire of larger Thresh disinfectors than those at first in use, than for a type which would stand the wear-and-tear on active service more satisfactorily.

The original pattern was attached to a horse-driven vehicle with iron-shod wheels, and this when driven over roads so rough as are many of those in Northern France and Flanders shook so much that pipe joints and steam-tight doors soon became defective. The chassis on which the present machine is carried has, like all other lorries, twin back wheels with solid rubber tyres. The vibration, therefore, is reduced to a minimum, provided the pace at which it is driven does not exceed ten or twelve miles an hour.

I understand that quite a large number of divisions are now supplied with a Thresh of this type.

Reviews.

Bedsores: Their Prevention and Cure. By Catherine M. Smart, Matron of Waddington Hospital, York. London: J. Bale, Sons and Danielsson, Ltd. 1916. Pp. 52. Price 1s. net.

This small book will supply a long-felt want, as one does not know of any brochure hitherto published on the subject.

One has always felt that too little attention to the treatment of bedsores has been paid by doctors, and it is generally left to the nurse to exercise her own discretion in the matter.

The chapter on prevention is excellent, and leaves nothing to be desired. The various remedies described are all good. One notices the omission of hydrogen peroxide and eusol as remedies for sloughing bedsores. Also, when mentioning adhesive plaster, the author might have specified oxide of zinc plaster as being less irritating to the skin than the ordinary adhesive plaster, which contains salicylic acid. The various utensils, also the bed and its requirements, are all well described. The small book is highly to be recommended and is most practical. No amateur nurse ought to be without it. C. M.

Notes on Military Orthopædics. By P. B. Roth, M.B., F.R.C.S., Captain R.A.M.C. (S.R.). London: H. Kimpton. 1916. Pp. 56. Price 1s.

This useful little manual has been recently written on a subject of great importance to military medical officers, by Captain Paul Bernard Roth, F.R.C.S., R.A.M.C. (S.R.), who gives the results of some of his experiences during fourteen months' War service. The author first deals with the treatment of "dropped foot" by means of a tin "night shoe," and points out that if a walking instrument is necessary the spring should be of *coiled wire*. "Fracture of the scaphoid," he states, "is quite common and often not diagnosed, but mistaken for sprained wrist or Colles's fracture." Sherren's splint is recommended for ulnar nerve paralysis.

The author is of opinion that rupture of the crucial ligaments of the knee is quite a common injury, occurring as the result of riding accidents or aeroplane falls; the only treatment is prolonged fixation in a moulded leather knee-splint.

As regards that unsatisfactory condition so often met with—viz., chronic synovitis of the knee—Captain Roth declares that if the affected knee be fixed in an apparatus (usually a "knee-cage") which will limit flexion for a sufficient length of time, cure will result. He emphasizes the importance of taking an X-ray photograph of every injured knee, and is of opinion that the best method of opening the knee-joint is by an anterior vertical incision through the patella. Three varieties of Thomas's knee-splint, together with Wallace's modification, are described and the method of application explained.

The author is of opinion that if a case of "static" genu valgum is over 21 years of age, it is unlikely that treatment by apparatus will

be effectual, osteotomy is not to be considered, and discharge from the Army will probably be necessary. Flat-foot is divided into four varieties and its treatment indicated.

The Thomas's sling is stated to be an excellent means of treating all injuries of the shoulder-joint, humerus, and elbow-joint, with one exception—fracture of the olecranon.

Thomas's leather posterior spinal splint for fracture of the fifth lumbar vertebra is recommended. Pes cavus can be successfully treated by tenotomy, and methods of treatment of corns and the prevention of their recurrence are given by the author.

Artificial limbs are dealt with, and it is stated that the patient should be wearing the limb within a month of amputation; extreme lightness of limb is actually a disadvantage, and it is questionable whether an *expensive* limb should be issued to every disabled soldier.

Captain Roth completes his book by inserting a memorandum on a proposed scheme for treatment of more or less permanently disabled crippled soldiers.

We can heartily recommend this volume to officers of the R.A.M.C., as it contains many valuable hints on a difficult subject.

THE INDIAN MANUAL OF FIRST AID. By Lieutenant-Colonel R. J. Blackham, C.I.E., R.A.M.C. Bombay: G. Claridge and Co. 1915. Twelfth Edition. Pp. xiv and 196. Price 1 rupee.

The most indifferent observer of First Aid during the last decade admits that it has been one of immense transition. Up and onward is, we know, the accepted order; still, the teacher and pupil must remember that the subject is "First Aid," therefore the introductory chapter might even more emphasize discrimination than resourcefulness. The need for this was quite recently shown at an examination. The question was "Treatment for choking." The reply was: "Hold head over a pillow, incise trachea with a pocket-knife, keep wound open with a piece of wire. . . ." Truly a little knowledge may be dangerous!

This little manual is compiled on common-sense lines, and the arrangement under appropriate "heads" is distinctly good.

The importance laid on the use of "improvised methods" is most praiseworthy. The tables for bleeding, insensibility, artificial respiration and poisons are excellent, though it would have been better if the use of alcoholic stimulants was left to the discretion of the medical man.

The illustrations are generally lucid, except for fig. 26, p. 45, which is poor. The treatment advocated for double fracture of the clavicle is certainly not the best in vogue.

The improvised bed cradle (fig. 70, p. 180) would necessitate putting the limb through the aperture, a course which might prove painful to the patient. A better plan would be to remove the bottom, so that the "cradle" could be placed over the limb without recourse to moving the latter.

With the exception of these few points, the book teems with much useful information, and should prove a source of value to both teacher and taught.

Correspondence.

OSMOSIS IN THE TREATMENT OF TROPICAL ABSCESS OF LIVER.

TO THE EDITOR OF "THE JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—I suggest the following treatment in tropical abscess of liver: After the abscess has been opened, two to three drachms of ten per cent ichthyol in glycerine should be injected into the abscess cavity every morning and evening. A drainage-tube should not be used; there is no risk of a premature closing of the external wound provided a free incision has been made in the skin. The wound should be painted with equal parts of ichthyol and glycerine and covered with gauze and absorbent wool. If ichthyol cannot be obtained, a dry, non-irritating antiseptic should be substituted. I have already advocated this treatment in external carcinoma. After removal of the growth the wound should be left open and painted twice daily with equal parts of ichthyol and glycerine with a view to preventing recurrence and subsequent diffusion. Here also, if ichthyol cannot be obtained, another antiseptic should be used.

I am, etc.,
C. W. DUGGAN,
Major R.A.M.C.

Military Hospital,
The Barracks, Lincoln.
April 21, 1916.

INDEX TO VOLUME XXVI.

C.N. = Clinical and other Notes.
C.L. = Current Literature.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

January, 1916.

EXTRACT FROM THE "LONDON GAZETTE," JANUARY 11 TO 14, 1916.

Central Chancery of the Orders of Knighthood.

Lord Chamberlain's Office,
St. James's Palace, S.W.,
January 14, 1916.

The King has been graciously pleased to give orders for the following promotions in, and appointments to, the Most Honourable Order of the Bath, for services rendered in connection with military operations in the Field. The promotions and appointments to date from the 1st instant:—

To be Additional Members of the Military Division of the Third Class, or Companions, of the said Most Honourable Order:—

Surgeon-General Richard William Ford, D.S.O.
Colonel Blenman Buhot Grayfoot, M.D., Indian Medical Service.
Colonel James Maher, Army Medical Service.
Colonel Michael John Sexton, M.D., Army Medical Service.
Colonel John Joshua Russell, M.B., Army Medical Service.
Colonel Edward George Browne, Army Medical Service.
Lieutenant-Colonel (temporary Colonel) Walter Calverley Beevor, C.M.G., M.B. (Retired Pay), Royal Army Medical Corps.
Major (temporary Colonel) Henry McIlree Williamson Gray, M.B., F.R.C.S., Royal Army Medical Corps, Territorial Force.
Temporary Colonel Sir Bertrand Edward Dawson, K.C.V.O., M.D., Royal Army Medical Corps, Territorial Force.

Central Chancery of the Orders of Knighthood.

Lord Chamberlain's Office,
St. James's Palance, S.W.,
January 14, 1916.

The King has been graciously pleased to give orders for the following promotion in, and appointment to, the Most Honourable Order of the Bath, for services rendered in connection with the War. The promotion and appointment to date from the 1st instant:—

To be Additional Member of the Military Division of the Third Class, or Companion, of the said Most Honourable Order:—

Colonel (temporary Surgeon-General) Michael William Russell, Deputy Director-General, Army Medical Service, War Office.

CHANCERY OF THE ORDER OF ST. MICHAEL AND ST. GEORGE.

Downing Street,
January 14, 1916.

The King has been graciously pleased to give directions for the following promotions in, and appointments to, the Most Distinguished Order of St. Michael and St. George, for services rendered in connection with military operations in the Field, to be dated January 1, 1916 :—

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order :—

Colonel William Watson Pike, D.S.O., F.R.C.S.I., Army Medical Service.
Colonel Charles Edward Nichol, D.S.O., M.B., Army Medical Service.
Colonel Bruce Morland Skinner, M.V.O., Army Medical Service.
Lieutenant-Colonel and Brevet-Colonel Frederick Smith, D.S.O., Royal Army Medical Corps.
Colonel George Douglas Hunter, D.S.O., Army Medical Service.
Temporary Colonel John Atkins, M.B., F.R.C.S., Army Medical Service.
Temporary Colonel William Tindall Lister, M.B., F.R.C.S., Army Medical Service.
Colonel Charles Augustus Young, Army Medical Service.
Colonel Stuart Macdonald, M.B., Army Medical Service.
Colonel Gerald Thomas Rawnsley, Army Medical Service.
Temporary Colonel Cuthbert Sydney Wallace, Army Medical Service.
Temporary Colonel Henry Alexis Thomson, M.D., F.R.C.S., Royal Army Medical Corps, Territorial Force.
Lieutenant-Colonel Ransom Pickard, M.D., Royal Army Medidal Corps, Territorial Force.
Lieutenant-Colonel Alfred Bertram Soltau, M.D., Royal Army Medical Corps, Territorial Force.
Lieutenant-Colonel John Archibald Hamilton, M.B., F.R.C.S., Indian Medical Service.
Lieutenant-Colonel Alexander Dunstan Sharp, Royal Army Medical Corps, Territorial Force.
Lieutenant-Colonel (temporary Colonel) Harry Alexander Hinge, Royal Army Medical Corps.
Lieutenant-Colonel Alexander Milne-Thomson, Royal Army Medical Corps, Territorial Force.
Lieutenant-Colonel Arthur Winsmore Hooper, D.S.O., Royal Army Medical Corps.
Lieutenant-Colonel George Abraham Moore, M.D., Royal Army Medical Corps.
Lieutenant-Colonel James Robert McMunn, Royal Army Medical Corps.
Lieutenant-Colonel Claude Kyd Morgan, M.B., Royal Army Medical Corps.
Lieutenant-Colonel Frederick Kiddle, M.B., Royal Army Medical Corps.
Lieutenant-Colonel William Henry Suyder Nickerson, V.C., M.B., Royal Army Medical Corps.
Lieutenant-Colonel Frederick Septimus Penny, M.B., Royal Army Medical Corps.
Lieutenant-Colonel Jonas William Leake, Royal Army Medical Corps.
Lieutenant-Colonel Francis John Brakenridge, Royal Army Medical Corps.
Lieutenant-Colonel Arthur Chopping, Royal Army Medical Corps.
Lieutenant-Colonel Henry Edward Manning Douglas, V.C., D.S.O., Royal Army Medical Corps.
Lieutenant-Colonel Langford Newman Lloyd, D.S.O., Royal Army Medical Corps.
Temporary Honorary Lieutenant-Colonel Charles Gordon Watson, F.R.C.S., No. 1 British Red Cross Hospital.
Major William Riach, M.D., Royal Army Medical Corps.
Major Wilfrid Wynne Jeudwine, M.D., Indian Medical Service.
Major Percival Davidson, D.S.O., M.B., Royal Army Medical Corps.

CANADIAN FORCE.

Colonel Murray MacLaren, Canadian Army Medical Corps.
Lieutenant-Colonel George Gallie Nasmith, Canadian Army Medical Corps.
Lieutenant-Colonel Arthur Edward Ross, Canadian Army Medical Corps.

NEW ZEALAND FORCE.

Lieutenant-Colonel William Henry Parkes, M.D., F.R.C.S., Commanding New Zealand Hospital.

War Office,
January 14, 1916.

His Majesty the King has been graciously pleased to approve of the undermentioned Honours and Rewards for Distinguished Service in the Field, with effect from January 1, 1916, inclusive:—

To be Brevet Colonels.

Lieutenant-Colonel A. J. Macnab, F.R.C.S., Indian Medical Service.
Lieutenant-Colonel J. M. Sloan, D.S.O., M.B., Royal Army Medical Corps.

To be Brevet Lieutenant-Colonels.

Major H. Boulton, M.B., Indian Medical Service.
Major G. Browse, M.B., Indian Medical Service.
Major F. G. FitzGerald, Royal Army Medical Corps.

To be Brevet Majors.

Captain M. G. Dill, M.D., Royal Army Medical Corps.
Captain C. N. Draycott, Royal Army Medical Corps, Territorial Force.
Captain C. H. S. Frankau, M.B., F.R.C.S., Royal Army Medical Corps, Territorial Force.
Captain R. C. Ozanne, Royal Army Medical Corps, Special Reserve.
Captain R. G. H. Tate, M.D., Royal Army Medical Corps.

To be Honorary Captains.

Quartermaster and Honorary Lieutenant M. Cohen, Royal Army Medical Corps, Territorial Force.
Quartermaster and Honorary Lieutenant C. H. Cooper, Royal Army Medical Corps.
Quartermaster and Honorary Lientenant G. W. Harris, Royal Army Medical Corps, Territorial Force.
Quartermaster and Honorary Lieutenant J. Keogh, Royal Army Medical Corps, Territorial Force.
Quartermaster and Honorary Lieutenant J. H. Maunder, Royal Army Medical Corps, Territorial Force.
Quartermaster and Honorary Lieutenant H. C. Okill, Royal Army Medical Corps, Territorial Force.

To be Granted the Next Higher Rate of Pay under Article 241 of the Royal Warrant.

Quartermaster and Honorary Lieutenant A. P. Barnard, Royal Army Medical Corps.
Quartermaster and Honorary Lieutenant E. Birch, Royal Army Medical Corps.
Quartermaster and Honorary Lieutenant T. D. Conway, Royal Army Medical Corps.
Quartermaster and Honorary Lieutenant F. Davis, Royal Army Medical Corps.
Quartermaster and Honorary Lieutenant C. A. Figg, Royal Army Medical Corps.
Quartermaster and Honorary Lieutenant R. H. Green, Royal Army Medical Corps.
Quartermaster and Honorary Lieutenant E. O'Hara, Royal Army Medical Corps.

To be Companions of the Distinguished Service Order.

Major Ralph Bignell Ainsworth, Royal Army Medical Corps.
Major Ernest Brabazon Booth, M.D., Royal Army Medical Corps.
Major George Herbert James Brown, M.B., Royal Army Medical Corps.
Major James Pearson Brown, M.B., Royal Army Medical Corps, Territorial Force.
Major Bernard Bruce Burke, Royal Army Medical Corps.
Major James Hamilton Campbell, M.B., Royal Army Medical Corps.
Major Philip George Easton, Royal Army Medical Corps.
Major Patrick John Hanafin, Royal Army Medical Corps.
Major Daniel Litton Harding, F.R.C.S.I., Royal Army Medical Corps.
Major James Andrew Hartigan, M.B., Royal Army Medical Corps.
Major Arthur Edmund Stewart Irvine, Royal Army Medical Corps.
Major Nelson Low, Royal Army Medical Corps.
Major Alban Anderson Meaden, Royal Army Medical Corps.
Major Richard Arthur Needham, M.B., Indian Medical Service.
Major Michael Balfour Hutchison Ritchie, M.B., Royal Army Medical Corps.

Major Frederick Emilius Roberts, Royal Army Medical Corps.
Major William Francis Roe, Royal Army Medical Corps, Territorial Force.
Major James Samuel Yeaman Rogers, M.B., Royal Army Medical Corps, Territorial Force.
Major Eugene Ryan, Royal Army Medical Corps.
Major Francis Cornelius Sampson, M.B., Royal Army Medical Corps.
Major Arthur Briton Smallman, M.D., Royal Army Medical Corps.
Major Richard James Campbell Thompson, Royal Army Medical Corps.
Major Charles Harold Turner, Royal Army Medical Corps.
Captain John Downie, M.B, Royal Army Medical Corps, Territorial Force.
Captain Joseph Wilfred Houston, M.B., Royal Army Medical Corps.
Captain William Porter MacArthur, M.D., F.R.C.P.I., Royal Army Medical Corps.
Captain Edward Michael O'Neill, M.B., Royal Army Medical Corps.
Captain Frank Worthington, M.B., Royal Army Medical Corps.
Temporary Lieutenant John Fraser Steven, M.B., Royal Army Medical Corps.

AWARDED THE MILITARY CROSS.

Captain Jonas William Anderson, M.B., Royal Army Medical Corps, Territorial Force.
Captain David Charles Gordon Ballingall, M.B., Royal Army Medical Corps.
Captain Henry Cuthbert Bazett, M.B., F.R.C.S., Royal Army Medical Corps, Special Reserve.
Captain Frederick Arnot Bearn, M.B., Royal Army Medical Corps, Special Reserve.
Captain Edward Charles Beddows, Royal Army Medical Corps.
Temporary Captain Lancelot Gerard Bourdillon, Royal Army Medical Corps.
Captain John Errol Moritz Boyd, Royal Army Medical Corps.
Captain Noel Godfrey Chavesse, M.B., Royal Army Medical Corps, Territorial Force.
Captain Albert George William Compton, Royal Army Medical Corps, Special Reserve.
Captain Harry Slater Cormack, M.B., F.R.C.S., Indian Medical Service.
Temporary Captain Robert Ewart Cree, M.B., Royal Army Medical Corps.
Temporary Captain Claude Gordon Douglas, M.D., Royal Army Medical Corps.
Captain John Cecil Alexander Dowse, M.B., Royal Army Medical Corps, Special Reserve.
Captain Philip Gordon Moss Elvery, Royal Army Medical Corps.
Captain Roger Errington, M.B., Royal Army Medical Corps, Territorial Force.
Captain Eric Alfred Charles Fazan, Royal Army Medical Corps, Territorial Force.
Temporary Captain James Henry Fletcher, Royal Army Medical Corps.
Temporary Captain William Foot, M.B., Royal Army Medical Corps.
Captain Robert Forgan, M.B., Royal Army Medical Corps, Special Reserve.
Captain Archibald John Gilchrist, M.B., Royal Army Medical Corps, Special Reserve.
Captain Owen Hairsine, Royal Army Medical Corps, Special Reserve.
Captain Travis Hampson, M.B., Royal Army Medical Corps, Special Reserve.
Captain Frederick Duke Gwynne Howell, Royal Army Medical Corps.
Temporary Captain Henry Rylands Knowles, M.B., Royal Army Medical Corps.
Captain Stanley Dermott Large, Royal Army Medical Corps.
Captain Hyman Lightstone, Royal Army Medical Corps, Territorial Force.
Temporary Captain Eric Francis Wallace Mackenzie, M.B., Royal Army Medical Corps.
Captain John MacMillan, M.B., Royal Army Medical Corps, Territorial Force.
Temporary Captain John Richardson Marrack, M.B., Royal Army Medical Corps.
Captain William Hilgrove Leslie McCarthy, M.D., Royal Army Medical Corps, Special Reserve.
Captain Campbell McQueen, Royal Army Medical Corps.
Temporary Captain George Millar, M.B., Royal Army Medical Corps.
Captain Sinclair Miller, M.B., Royal Army Medical Corps, Special Reserve.
Captain Thomas Mackinlay Miller, Royal Army Medical Corps, Special Reserve.
Captain John Murdock, M.B., F.R.C.S., Royal Army Medical Corps, Territorial Force.
Temporary Captain George Ernest Neligan, M.B., F.R.C.S., Royal Army Medical Corps.
Captain Roger Brighouse Nicholson, Indian Medical Service.

Captain John Joseph O'Keeffe, M.B., Royal Army Medical Corps.
Captain William Calder Paton, M.B., Indian Medical Service.
Captain Gerard Petit, Royal Army Medical Corps.
Temporary Captain Robert Cecil Robertson, M.B., Royal Army Medical Corps.
Temporary Captain Thomas Victor Somerville, Royal Army Medical Corps.
Captain Sumner Hugh Smith, Royal Army Medical Corps.
Captain Clifford William Sparks, Royal Army Medical Corps, Special Reserve.
Captain Evelyn Alexander Sutton, Royal Army Medical Corps.
Captain Frederick Thomas Turner, Royal Army Medical Corps.
Captain Quentin Vaughan Brooke Wallace, M.D., Royal Army Medical Corps, Special Reserve.
Temporary Captain John Richard Menzies Whigham, Royal Army Medical Corps.
Captain Charles Albert Wood, M.B., Indian Medical Service.
Captain Thomas Wilson Wylie, M.B., Royal Army Medical Corps, Special Reserve.
Temporary Captain Robert Frew Young, M.B., Royal Army Medical Corps.
Temporary Lieutenant Patrick Cagney, Royal Army Medical Corps.
Temporary Lieutenant Harold Cane Godding, Royal Army Medical Corps.
Temporary Lieutenant James Towers Kirkland, M.B., Royal Army Medical Corps.
Temporary Lieutenant Richard Hugh McGillycuddy, Royal Army Medical Corps.
Temporary Lieutenant Alfred Reginald Roche, Royal Army Medical Corps.
Temporary Lieutenant Harold Arthur Rowell, Royal Army Medical Corps.
Temporary Lieutenant Algernon Charles Stanley Smith, Royal Army Medical Corps.
Temporary Lieutenant William Norman Watson, M.B., Royal Army Medical Corps.
Temporary Lieutenant Archibald Francis Wright, M.B., Royal Army Medical Corps.
No. 10573 Serjeant-Major William Henry Chudleigh, Royal Army Medical Corps.
No. 10073 Serjeant-Major William Merchant, Royal Army Medical Corps.
No. 1097 Serjeant-Major Edward Tully Moxham, Royal Army Medical Corps, Territorial Force.

The undermentioned non-commissioned officers and men are promoted to the rank indicated against their rank:—

No. 19937 Corporal G. T. Platford, Serjeant.
No. 30417 Private T. H. Brooke, Corporal.
No. 18021 Private J. Carleton, Corporal.
No. 1339 Private H. Dodsworth, Corporal.
No. 34625 Private T. Foreman, Corporal.
No. 20620 Private W. Henry, Corporal.
No. 8035 Private C. E. Heywood, Corporal.
No. 19027 Private J. Higham, Corporal.
No. 730 Private T. Kelly, Corporal.
No. 8333 Private W. H. Marklew, Corporal.
No. 42025 Private J. Morris, Corporal.
No. 9266 Private R. Pemberton, Corporal.
No. 5605 Private A. T. Rose, Corporal.
No. 46951 Private H. Scandrett, Corporal.
No. 42825 Private W. Strachan, Corporal.
No. 9007 Private R. Treglown, Corporal.
No. 8368 Private F. G. Whitbread, Corporal.
No. 6587 Private C. Wright, Corporal.

Awarded the Distinguished Conduct Medal.

No. 372 Serjeant C. Abnett, 1st Home Counties Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 2135 Corporal E. Allen, 26th Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 47768 Private A. Barton, Royal Army Medical Corps (recently transferred to Royal Engineers).

No. 1502 Private F. Bennison, Royal Army Medical Corps.

No. 1861 Private J. G. Bruce, 1st Reserve Highland Field Ambulance, Royal Army Medical Corps, Territorial Force (formerly 2/1st).

No. 20413 Corporal D. Burch, Special Reserve, Royal Army Medical Corps

No. 32712 Private E. G. Butcher, Royal Army Medical Corps.

No. M2/074942 Driver G. E. Caley, Army Service Corps (attached Royal Army Medical Corps).

No. 1147 Corporal H. Carley, 1st Yorkshire Mounted Brigade Field Ambulance, Royal Army Medical Corps, Territorial Force.

No. 2337 Private D. W. Darling, 2nd London Sanitary Company, Royal Army Medical Corps, Territorial Force.
No. 35664 Serjeant R. Davis, Royal Army Medical Corps.
No. 677 Staff-Serjeant E. Dymond, Welsh Border Mounted Brigade Field Ambulance, Royal Army Medical Corps, Territorial Force (attached 7th Cavalry Brigade Field Ambulance).
No. 30902 Serjeant E. Eyre, Royal Army Medical Corps.
No. T/22199 Acting-Serjeant F. Freathy, Army Service Corps (attached Royal Army Medical Corps).
No. 34110 Private W. Gant, Royal Army Medical Corps.
No. 4093 Private J. Grundy, Royal Army Medical Corps.
No. 51088 Private G. T. Halls, Royal Army Medical Corps.
No. 3311 Private W. Hanson, Royal Army Medical Corps.
No. 113 Serjeant S. M. Harrie, 3rd London Field Ambulance, Royal Army Medical Corps, Territorial Force.
No. 12433 Private C. A. T. Hughes, Royal Army Medical Corps.
No. 46084 Lance-Corporal A. E. Jeffers, Royal Army Medical Corps.
No. 727 Serjeant W. F. Jenkins, 2nd Home Counties Field Ambulance, Royal Army Medical Corps, Territorial Force.
No. 1714 Corporal L. Kennady, 1st Northumbrian Field Ambulance, Royal Army Medical Corps, Territorial Force.
No. 10363 Private G. Kilpack, Royal Army Medical Corps.
No. 17767 Staff-Serjeant H. G. Kimber, Royal Army Medical Corps.
No. 17898 Private W. Knagg, Royal Army Medical Corps.
No. 365 Private F. McGarry, Royal Army Medical Corps.
No. 45 Staff-Serjeant T. J. Moffatt, Royal Army Medical Corps.
6017 Corporal H. Moody, Royal Army Medical Corps.
38070 Lance-Corporal J. R. Morrison, Royal Army Medical Corps.
19807 Private E. J. Murphy, Royal Army Medical Corps.
1993 Serjeant E. G. Passingham, Royal Army Medical Corps.
14082 Staff Serjeant G. Prince, Royal Army Medical Corps.
9027 Private P. T. Pronger, Royal Army Medical Corps.
2093 Acting-Serjeant E. Roberts, 2nd London Field Ambulance, Royal Army Medical Corps.
4919 Private T. Roberts, Royal Army Medical Corps.
2275 Corporal W. C. Ross, Royal Army Medical Corps.
754 Serjeant H. Russell, Royal Army Medical Corps.
10711 Serjeant-Major F. W. Sharpe, Royal Army Medical Corps.
739 Serjeant W. Sharpe, 2nd Home Counties Field Ambulance, Royal Army Medical Corps, Territorial Force.
41218 Lance-Corporal E. Shepherd, Royal Army Medical Corps.
1269 Lance-Corporal G. Snowden, 1/2nd Northumbrian Field Ambulance, Royal Army Medical Corps.
478 Private R. Symes, Royal Army Medical Corps.
440 Private F. Taylor, Royal Army Medical Corps.
9467 Staff-Serjeant C. J. Tunn, Royal Army Medical Corps.
1911 Corporal N. W. J. Turnbull, Royal Army Medical Corps.
515 Lance-Serjeant J. W. Wagg, 1st North Midland Field Ambulance, Royal Army Medical Corps, Territorial Force.
20747 Private H. Wallis, 1st Home Counties Field Company, Royal Army Medical Corps, Territorial Force.
5367 Private A. J. Weston, Royal Army Medical Corps.
41 Corporal R. Whitman, 1st Lowland Field Ambulance, Royal Army Medical Corps, Territorial Force.
20852 Private H. Wilkinson, Royal Army Medical Corps.

AWARDED THE ROYAL RED CROSS DECORATION, 1ST CLASS.

Queen Alexandra's Imperial Military Nursing Service.

Miss A. L. Cox (Matron).
Miss E. A. Cox (Matron).
Miss M. L. Rannie (Matron).
Miss M. J. Hepple (Sister, temporary Matron).
Miss P. Steele (Sister, temporary Matron).
Miss D. M. Taylor (Sister, temporary Matron).
Miss M. Walker (Sister, temporary Matron).

Queen Alexandra's Imperial Military Nursing Service (Reserve).

Miss C. Elmslie (Matron) Military Isolation Hospital, Aldershot.
Miss E. C. O. Leggatt.
Miss G. C. Moxon.

Territorial Force Nursing Service.

Miss A. B. Baillie (Principal Matron), 2nd Southern General Hospital, Bristol.
Miss M. Bird (Principal Matron), 2nd Eastern General Hospital, Brighton.
Miss E. F. C. Brown (Principal Matron), 1st Northern General Hospital, Newcastle-on-Tyne.
Miss R. Cox-Davies (Principal Matron), 1st London General Hospital, London
Miss C. Crookenden (Principal Matron), 1st Eastern General Hospital, Cambridge.
Miss E. Edmondson (Principal Matron), 1st Scottish General Hospital, Aberdeen.
Miss H. Gregory Smith (Principal Matron), 3rd Scottish General Hospital, Glasgow.
Miss E. S. Innes (Principal Matron), 2nd Northern General Hospital, Leeds.
Miss J. Melrose (Principal Matron), 4th Scottish General Hospital, Glasgow.
Miss E. M. Musson (Principal Matron), 1st Southern General Hospital, Birmingham.
Miss M. E. Ray (Principal Matron), 4th London General Hospital, London.
Miss J. Sheppard (Principal Matron), 4th Northern General Hospital, Lincoln.
Miss W. C. Smeeton (Principal Matron), 3rd Northern General Hospital, Sheffield.
Miss M. E. Sparshott (Principal Matron), 2nd Western General Hospital, Manchester.
Miss C. E. Vincent (Principal Matron), 5th Northern General Hospital, Leicester.
Miss A. Watt (Principal matron), 3rd Southern General Hospital, Oxford.
Miss E. A. M. Wilson (Principal Matron), 3rd Western General Hospital, Cardiff.
Miss E. Holden (Matron), 3rd London General Hospital, London.
Miss C. A. T. McKay (Matron), 4th Southern General Hospital, Plymouth.
Miss A. M. Milligan (Matron), 2nd Scottish General Hospital, Edinburgh.
Miss H. R. Oates (Matron), 1st Western General Hospital, Liverpool.
Miss M. S. Riddell (Matron), 2nd London General Hospital, London.
Miss K. A. Smith (Matron), 5th Southern General Hospital, Southsea.

AWARDED THE ROYAL RED CROSS DECORATION 2ND CLASS.

Queen Alexandra's Imperial Military Nursing Service.

Miss C. A. Stevens (Staff Nurse, Acting Matron).
Miss G. Witter (Staff Nurse, temporary Sister).

Queen Alexandra's Imperial Military Nursing Service (Reserve).

Miss M. M. Brown (Acting Matron).
Miss E. Fothergill (Sister), Military Isolation Hospital, Aldershot.
Miss E. Sturdy (Sister), Military Isolation Hospital, Aldershot.
Miss M. L. Ward (Sister), Military Isolation Hospital, Aldershot.
Miss I. Cameron.
Miss M. Pretyman.
Miss L. M. Terrell.

Territorial Force Nursing Service.

Miss M. E. Dickinson (Sister), 1st Western General Hospital, Liverpool.
Miss A. P. Douglas (Sister), 2nd Scottish General Hospital, Edinburgh.
Miss W. M. Flint (Sister), 1st Eastern General Hospital, Cambridge.
Miss C. A. Padbury (Sister), 2nd London General Hospital, London.

THE KING has been graciously pleased to give orders for the following promotion in, and appointments to, the Most Honourable Order of the Bath.

To be Ordinary Member of the Military Division of the Third Class, or Companion of the said Most Honourable Order:—

Brevet Colonel William Westropp White, Indian Medical Service.

The King has been graciously pleased to give directions for the following promotions in, and appointment to, the Most Distinguished Order of Saint Michael and Saint George.

To be Ordinary Member of the Third Class, or Companion of the said Most Distinguished Order:—

Surgeon-General Guy Carleton Jones, Director of Medical Services, Canadian Expeditionary Force.

The King has been graciously pleased to make the following promotion in, and appointment to, the Most Eminent Order of the Indian Empire.

To be Companion of the said Most Eminent Order:—

Lieutenant-Colonel Robert Charles MacWatt, Indian Medical Service, Chief Medical Officer, Rajputana, and Civil Surgeon, Ajmer.

The King has been graciously pleased to make the following promotion in, and appointment to, the Royal Victorian Order.

To be Knight Commander:—

Surgeon-General Sir Anthony Alfred Bowlby, K.C.M.G., F.R.C.S., Surgeon in Ordinary to His Majesty.

The King has been graciously pleased to confer the Decoration of the Royal Red Cross upon Miss Margaret Clothilde Macdonald, Matron-in-Chief, Canadian Nursing Service.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers, in recognition of their gallantry and devotion to duty in the Field:—

Temporary Captain Henry James Burke, R.A.M.C. (attached 1/8th Battalion, West Yorkshire Regiment, T.F.).

For conspicuous gallantry on November 8, 1915, near Turco Farm. A serjeant in the front line had his leg crushed by the blowing in of a dug-out, and Captain Burke found immediate amputation necessary. In order to save time he crawled across the open to get his instruments, while the enemy turned a machine gun on to him. In spite of their fire he returned the same way, and coolly performed the operation in the trench while the enemy were shelling it heavily.

Temporary Captain Bartholomew James Hackett, M.B., R.A.M.C. (attached 7th Batt. Suffolk Regiment).

For conspicuous gallantry and devotion to duty at Loos on October 2, 1915. When the battalion to which he was attached had suffered very heavy casualties and had run out of dressings, Captain Hackett brought up a fresh supply from the dressing station, crossing over about a hundred yards in the open. He has frequently attended the wounded under fire and has shown great bravery.

ARMY MEDICAL SERVICE.

The undermentioned Lieutenant-Colonels to be temporary Colonels whilst holding the appointments of Assistant Directors of Medical Services:—

Dated November 3, 1915.—Frederick W. Hardy, M.B.

Dated November 5, 1915.—Charles E. Pollock.

Dated November 6, 1915.—Lewis Way.

Dated November 18, 1915.—Frank A. Symons, D.S.O., M.B.; George W. Brazier-Creagh, C.M.G., whilst Assistant Director of Medical Services of a Division.

The undermentioned to be temporary Colonels:—

Dated November 15, 1915.—Thomas Sinclair, M.D., F.R.C.S.

Dated November 26, 1915.—Temporary Lieutenant-Colonel Arthur E. J. Barker, F.R.C.S., Royal Army Medical Corps (Major, 3rd London General Hospital, Royal Army Medical Corps, Territorial Force.)

Dated November 27, 1915. –Fleming Mant Sandwith, M.D., F.R.C.P.

Colonel Robert H. Firth is retained on the Active List under Articles 120 and 522, Royal Warrant for Pay and Promotion, 1914, dated December 1, 1915.

Temporary Colonel George L. Gulland, M.D., relinquishes his commission, dated December 11, 1915.

Colonel Robert S. F. Henderson, K.H.P., is retained on the Active List, and to be supernumerary, dated December 11, 1915.

Colonel Edward H. L. Lynden-Bell, C.B., is retained on the Active List under the provisions of Articles 120 and 522, Royal Warrant for Pay and Promotion, dated December 18, 1915.

Colonel James Maher is retained on the Active List, under the provisions of Articles 120 and 522, Royal Warrant for Pay and Promotion, dated December 27, 1915.

ROYAL ARMY MEDICAL CORPS.

The undermentioned to be Temporary Lieutenant-Colonels:—

Dated August 11, 1915.—Lieutenant-Colonel D. Macauley, South African Medical Corps.

Dated September 1, 1915.—Colonel Peter B. Giles, C.B., late Territorial Force.

Dated November 1, 1915.—Major Sir Edward S. Worthington, Kt., C.M.G., M.V.O., whilst Commandant, Officers' Convalescent Home, Cimiez.

Dated December 8, 1915.—John Charles Grant Ledingham, M.B.

Supernumerary Lieutenant-Colonel George A. T. Bray is restored to the Establishment, dated November 25, 1915.

Major H. Hemsted, South African Medical Corps, to be temporary Major, dated August 13, 1915.

Temporary Lieutenant Frederick Buick McCarter, M.B., to be temporary Captain, dated November 25, 1915.

Major Charles C. Fleming, D.S.O., M.B., Retired Pay (Reserve of Officers), to be Assistant Director of Medical Services, Highland Division, with the rank of Colonel, dated April 17, 1915.

Major Farquhar Maclennan, M.B., to be a Deputy-Assistant Director-General, dated November 20, 1915.

Major Alfred Wright, Reserve of Officers, to be local Lieutenant-Colonel whilst Senior Medical Officer, Cape Town, dated November 5, 1915.

Temporary Major Thomas Mill, M.B., F.R.C.S., having resigned his appointment at the Beaufort War Hospital, relinquishes his commission, dated November 30, 1915,

Lieutenant-Colonel Ernest Brodribb is placed temporarily on the Half Pay List on account of ill-health, dated December 18, 1915.

Temporary Lieutenant Joseph Brewer is placed temporarily on Retired Pay on account of ill-health, dated November 14, 1915. (Substituted for the notification which appeared in the *Gazette* of November 17, 1915).

The notification regarding temporary Lieutenant Armitage E. F. L. Forbes, which appeared in the *Gazette* of December 3, 1915, is cancelled.

The appointment to a temporary Lieutenancy of Charles D. Halcombe, M.B., is antedated to September 4, 1915.

The names of the undermentioned temporary Lieutenants are as now described, and not as stated in the *Gazettes* of September 15, 1914, June 7, 1915, and November 19, 1915, respectively:—

Edward Seally, M.B.

Norman Devereux.

Frank William Martin, M.B.

Temporary Lieutenant James M. J. A. Levins is removed from the Army for absence without leave, dated October 18, 1915.

Temporary Honorary Captain Harold Pritchard, M.D., to be temporary Honorary Major whilst serving with No. 1 British Red Cross (Duchess of Westminster's) Hospital, dated December 11, 1915.

Temporary and Honorary Captain William P. S. Branson, M.D., F.R.C.P., to be temporary Honorary Major whilst serving with No. 1 British Red Cross (Duchess of Westminster's) Hospital, dated December 1, 1915.

The appointment to a temporary Lieutenancy of William R. S. Watkins is antedated to December 15, 1914.

Lieutenant Frederick John Cleminson, F.R.C.S., Royal Army Medical Corps, Territorial Force, to be temporary Lieutenant, dated October 21, 1915. (Substituted for the notification which appeared in the *Gazette* of November 19, 1915.)

The undermentioned relinquish their commissions:—

Dated November 8, 1915.—Temporary Captain Guy A. C Mitchell, M.B.

Dated November 24, 1915.—Temporary Lieutenant James Matheson, M.B.

The name of temporary Lieutenant Ian Ogilvie, M.B., is as now described, and not as stated in the *Gazette* of July 17, 1915.

Temporary Lieutenant Thomas E. Ashley, is dismissed the Service by sentence of a General Court-Martial, dated November 11, 1915.

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated August 15, 1915.—William L. G. Davies.

Dated September 10, 1915.—William W. Deans.

Dated September 26, 1915.—Ernest R. G. Greville.

Dated October 1, 1915.—David Thomson, M.B.

Dated October 2, 1915.—John R. P. Allin.

Dated October 3, 1915.—Geoffrey Hadfield, M.D.

Dated October 5, 1915.—James H. Aikman, M.B.; William C. Jardine, M.B.

Dated October 7, 1915.—William H. Laslett, M.B.; Malcolm A. MacDonald, M.B.

Dated October 10, 1915.—Thomas Fehily, Mark Bates, M.B., F.R.C.S.; James A. Glover, M.D.; Norbert Reader, M.B.; Wilfred V. Macaskie, M.B.; George

Jackson, M.B.; Edgar A. Pearson, M.B.; William J. Nisbet, M.B.; Michael J. Murray, M.B.

Dated October 11, 1915.—Frederick W. McMillan, M.B.

Dated October 12, 1915.—Trevor O. Williams, M.B.

Dated October 19, 1915.—John E. Cox.

Dated October 21, 1915.—Charles J. Kelly, David W. Reid, M.B.; Charles H. Thompson, Richard Williams; Charles G. H. Moore, M.B.; Garnett W. Twigg, M.D.

Dated October 22, 1915.—Trevor R. Snelling.

Dated October 24, 1915.—Roland R. Wettenhall, M.B.

Dated October 28, 1915.—Martin W. Littlewood, M.B.

Dated November 1, 1915.—Arthur G. Wilkinson, M.B.; Hugh Y. Riddell, M.B.

Dated November, 2, 1915.—Harold Mowat, M.D.; Percy G. Lock.

Dated November 7, 1915.—Alexander J. Couper; Lawrence T. Dean, M.B.; John T. McCullagh, M.B.

Dated November 9, 1915.—Idwal J. Williams, M.D.

Dated November 10, 1915.—Frederick E. Wynne, M.B.; John L. Menzies, M.B.; Richard O. H. Jones; James A. Delmege; Cecil Charles Bullmore; Joe D. Yule, M.B.

Dated November 11, 1915.—Herbert M. Cockcroft; James McManus; Bruce A. West, M.D.; Richard L. Barwick; Harold T. Mant, M.B., F.R.C.S.; John I. Russell, M.B.

Dated November 12, 1915.—Alexander W. Young, M.D., F.R.C.S.Edin.

Dated November 13, 1915.—James B. Mitton, M.B.; James P. O'Flynn, M.B.

Dated November 14, 1915.—Kenneth J. Yeo; Arthur N. Hooper; Walter H. Kiep, M.B.; Frederick Carson, M.B.; Alexander J. Kendrew, M.B.; Thomas W. G. Hogg, M.B.

Dated November 16, 1915.—George D. Yates, M.D.; Francis J. Morris; Robert C. Maclachlan, M.B.; Arthur E. Moore, M.D.; Albert E. M. Woolf, M.B., F.R.C.S.; Samuel P. Rea, M.B.; Alfred Tennyson Smith, M.D.

Dated November 17, 1915.—Joseph Burfield, M.B., F.R.C.S.; John Smyth Morrow, M.D.; John B. Fisher, M.D.

Dated November 18, 1915.—Archibald L. McLean, M.D.; Andrew B. Raffle, M.D.

Dated November 21, 1915.—Cecil Clarke, M.D.; John I. Shepherd, M.D.; Charles H. Fennell, M.D.; George J. Wilson, M.B.; Albert E. Salkeld; Percival C. Cole; John Francis Robert Gairdner, M.B.

Dated November 22, 1915.—William Rankin, M.B.; Norman Henry Oliver; William Poole Henley Munden, M.D.; John C. Matthews.

Dated November 23, 1915.—George L. Atkinson; Lionel C. Ferguson; Alexander G. Higgins; Arthur G. M. Middleton; Charles J. Singer, M.D.; Keith D. Falconer, M.B.; William A. Murphy, M.B.; Lawrence W. Bain, M.B.; Walter De M. Hill; James MacGregor, M.D.; Norman C. Patrick; Basil C. Ashton, M.B.; John Lawrence Rentoul, M.B.

Dated November 24, 1915.—Crawford Lundie, M.B.; Walter Amsden; Donald Clark, M.B.; Henry W. Teague, M.B.; Edward H. H. Granger; Cunison D. Rankin, M.D.; Charles J. A. N. Mercier, M.B.; Alexander Galletly, M.B.; Fred A. R. Hacker.

Dated November 25, 1915.—Alexander Edmond Knight, M.B.; Clifford T. Plimsoll; Harold F. Metcalf; Walter L. Cocker; Clarence L. B. White, Hugh H. C. Fuller, M.B.

Dated November 26, 1915.—Arthur Davies, M.D.; Norman C. Graham, M.B.; Gilbert Charles Chubb, M.B., F.R.C.S.

Dated November 27, 1915.—Charles A. Kenny.

Dated November 28, 1915.—Thomas Grimson, M.B.

Dated November 29, 1915.—Edwin F. O'Connor, M.B.

Dated November 30, 1915.—Lewis H. I. Bell, M.B.; Holden Carson, M.B.; Robert J. English, M.B.; Charles J. Morton, M.D.

Dated December 1, 1915.—Frederick William Twort; Hugh Dickie, M.D.; Thomas Gillman Moorhead, M.D.; George Beley, from the York and Lancaster Regiment.

Dated December 3, 1915.—Norman F. Hallows, M.B.

Dated December 10, 1915.—Francis Robert Seymour, M.D.

Dated December 21, 1915.—Alexander Gibson, M.B., F.R.C.S.; Cyril Wace, F.R.C.S.; Eric Bellingham Smith, M.D.

Dated December 22, 1915.—Reginald W. Gemmell, M.B.

Dated January 2, 1916.—James Keenan, F.R.C.S.I.

The undermentioned to be temporary Lieutenants:—

Dated October 14, 1915.—James Roberts Boyd, M.D.

Dated October 25, 1915.—Harold Edward Sutherland Stiven, M.D.
Dated October 27, 1915.—James St. Pierre Knight, M.B.
Dated October 30, 1915.—Charles William Sharp.
Dated November 9, 1915.—David William Jones, M.B.; Lancelot Toke Burra, M.D.
Dated November 10, 1915.—Robert Lewers Keown, M.B.; James William Fox; Lionel John Hood, M.B.; James Littleton Lawry, M.D.; Charles Owen Jones, M.D.; Samuel Vernon Robinson; Cecil Hubert Gostwyck Gostwyck, M.B.; Henry Dobree Woodroffe, M.D.; George Elsworth, M B.; George William Gower, M.B.; Mark Anthony; William Roche; George Herbert Heywood Russell; Marcus Mackenzie, M.B.; Leonard Mortis Webber; Victor Howard Lucien MacSwiney; Alger Roy Oram, M.B.; William Gemmill, M.B., F.R.C.S.Edin.; Arthur Barrett Cardew, M.B., F.R.C.S.Edin.; Charles Derwent Walker, M.B.; Thomas John Ryan; Alexander Garrow.
Dated November 11, 1915.—Henry Charles Heathcote, M.B.; Clement Alston Hughes, M.B.; Seymour Alfred Millen; Horace Lance Flint, M.B.
Dated November 12, 1915.—Edward Morgan Fannin, M.B.; Lancelot Moyle Breton; John Ritchie Richmond Ritchie, M.B.; Geoffrey Troughton Foster Smith, M.B.; Herbert Tomlin, M.D.; Archibald Turner Macleod Blair, M.B.; John Arthur Rinder Glennie, M.B., Thomas Buckley Williams, M.B.; Kenneth Cresdel MacNaught.
Dated November 14, 1915.—Henry Bourne, M.B.; Cuthbert Lindsay Emmerson; Richard Sydney Jenkins; Walton Ronald Wilson.
Dated November 15, 1915.—Lloyd John Hollis Oldmeadow, M.D., F.R.C.S.Edin.; Horace Montague Dimock Townshend, M.D.; Peter Mortimer Turnbull, M.B.; John Hobart Nixon, M.D.; Hugh Crichton Miller, M.D.; James Muir Nelson Paton, M.B.; Thomas Mayne Reid Waddell; Ainslie Booth, M.B.; Ernest Frederick Reeve, M.B.; Harold Hugh Fairfax; Henry Whitehead, M.D.; Robert Peel Thomson; George William Peake Maitland, M.B.; Henry Holt, M.B.; Hugh O'Neill, M.B.; Eric Francis Buckler, M.B.; Charles Fraser, M.D.; Richard Ernest Howell Leach, M.D.; Gerald Waddington Beresford, F.R.C.S.; James Edward Russell Orchard, M.B.; Eric Delefield Lindow; Gerald Laurence; Frederick Charles Carlé, M.B.; William Bainbridge, M.B.; Cecil Charles Brandon Thompson; Eustace Robert Barton; George Hely Hutchinson Almond, M.B.; Ronald Gray Gordon, M.D.; Francis James Lidderdale, M.B.; Alfred Ridley Hargreaves; James Walter McDonald, M.B.; Cecil Edgar Badcock; Herbert Royson Seers.
Dated November 16, 1915.—John Spears, M.B.; Alexander Montgomery, M.B.
Dated November 17, 1915.—William David Rose, M.B.; Dominick Thomas O'Flynn; John George Dods, M.D.; Isaac Flack; Henry Dean Haworth, M.D.; Herbert Barford Minshull; Arthur William Thirkill Whitworth, M.B.; Joseph Burnett Wilman; Vivian Ernest Ridewood; James Alexander Davidson, M.D.; Cyril Bowdler Henry.
Dated November 18, 1915.—Arthur Alexander Smith; John Anderson, M.B.; Frank Howard Lawson; Thomas Russell; Alfred William George Woodforde, M.B.; Ernest Cottew Moore, M.B., F.R.C.S.Edin.; Robert Nimmo Watson; Thomas McGibbin Fletcher, M.B.; Hugh Smith; John Cropper, M.D.; Anthony Alfred Watson, M.B.; Frederick William Rigby, M.B.; Andrew Chalmers Fleming; Ernest McIntyre; Octavus Walter Bateman; Rae McRae, M.D.
Dated November 19, 1915.—Philip O'Connell White; Francis Charles Lees; Gerard Ford Porter, M.D., F.R.C.S.Edin.; George Vigers Worthington, M.B.; Richard Benedict Hennessy, M.B.
Dated November 20, 1915.—Francis Arthur Winder, M.B.; Alexander Whytte, M.D.; John Hutchinson Crofton, M.B.; Joseph Hume Patterson; Charles James Lodge Patch; Paul Jenner Verrall, M.B., F.R.C.S.; Robert Dillon Lemon, M.B.; William Ernest Gemmell, M.B.; Edward Walter Longden; Peter Lornie, M.D.; Arthur Mudie; Alexander John Reid Taylor, M.B.; William Thomson Munro, M.D.; Martyn Wilfred Baker, M.B.; Archibald Randolph Fulton Douglas; John Aitken Gilfillan, M.B., Raymond John Jones, M.B.
Dated November 21, 1915.—Henry Ellis Robinson; Simon Simons; Hubert Henry Lacey Ellison; William Sugden Williamson; Walter Dickson, M.D.
Dated November 22, 1915.—Stephen Infield; Harry Bacon Wilkinson: Arthur Llewellyn Vaughan; David Clow, M.B.; William McConnell, M.B.; James Thomas Reardon; Douglas James Guthrie, M.D., F.R.C.S.Edin.; Edward Albert Seale, M.B.; Douglas Charles Murray Page; Louis Levy, M.B.; Reginald William Gemmell, M.B.; Arthur Wellington Saul MacComiskey, M.B.; Gilbert Bahn Thwaites, M.D.; Ernest Charles Lambert, M.D.; Edward William Dacre Hardy.

Dated November 22, 1915.—George Rowlands Boorer.

Dated November 23, 1915.—Sydney Herbert Jones: Second Lieutenant Henry Hemsted Mallet, from Scottish Horse Yeomanry; William Duke Georges Mulloy, M.B.; William Gloag Galletly, M.B.; Allan Douglas Low; John Honeyford, M.D., F.R.C.S.Edin.; John Craig, M.B.; William Edwin Plummer; James Alfred Frost; Henry Dewi Hampton Willis-Bund; Herbert Pank Thompson, M.D., F.R.C.S.Edin.

Dated November 24, 1915.—James Maxwell Adams-McVey; Joseph Humphreys; David Whiteside Maclagan, M.D.; John Alexander Black, M.B.; James St. Laurence Kirwan, M.B.; William George Silvester.

Dated November 25, 1915.—Reginald Roberts; Edward Prall; William Joseph Edward Stuttaford; Sydney Buxton Legge, M.D.; Elie Philip Marett; Arthur Bailey Pugh; Alfred Malseed, M.B.; Joseph Sydney Dickson, M.B.; William Tyrrell Patterson, M.B.; George Edwin Lindsay, M.B.; Maurice Angelo Spotswood; John Rudolf Elwood; Hugh Francis Williams; Frederick William Daniels, F.R.C.S.; Adam Gray, M.D.; Alec Barber, M.B.

Dated November 27, 1915.—Edward Sutcliffe; John Unsworth, M.B.; Owen David Baker Mawson; William Bannerman, M.B.; Harold Pace Gibb, M.B., F.R.C.S.; Gerald Francis Bird, M.B.; Cyril Henry Edwards, M.B.

Dated November 28, 1915.—Cuthbert Edmund Arnold Huddart.

Dated November 29, 1915.—Robert Blackie Austin, M.B.; William Ernest Hills; Joseph Scott Taggart, M.B.; Thomas Ewing, M.B.; David McMurray Dickson; Robert Anderson.

Dated November 30, 1915.—Robert Henry Shepard; Ian Finlayson MacKenzie; William Parker, M.B.

Dated December 1, 1915.—William Bligh, M.D.; James Robert Craig, M.B.; Thomas Christopher Harke; Robert James Bethune, M.D.; Neville Henry Austin; John Farquhar MacLeod, M.B.; Thomas Herbert Oliver, M.B.; Basil Edward Spurgin, M.B.; William Stirling, M.B.; Michael Gladstone Pettigrew; James Garden Gray; Richard Harding Bremridge, M.B.; Reginald Henry Urwick, M.D.; Arthur Edwin Fiddian; William Maxwell Penny, M.D.; John Bowen-Jones; William Edward Barker, M.B.; Harold Rosser Styleman Walford; Rupert John Vernon, M.B.; Algernon James Beadel; James Arthur Lowry, M.D.; Archibald Campbell, M.B.; John Cayley Padwick; John Alban Kendall Griffiths, M.B.; Samuel Robert Dudley; Arthur William Senior; Charles Hornan Givan Ross, M.B.; William Wrigley Stacey, M.B.; Leslie Muir Smith; George Bent Buckley; Gruner Stowell, M.B.; Thomas Henry Clarke; Philip Verdon; Percy Lyndon Moore, M.B.; John William Jackson, M.B.; Thomas Munn Body; Charles Claud Twort, M.D.; Alexander Gordon Peter, M.B.; Hugh Lowrie Askham; Arthur William Wilcox, M.D.; George Donaldson Edie Tullis, M.B.; Charles Henry Ferguson, M.B.; Walter Crabtree, M.B.; James Williamson Tocher, M.B.; John Rawlings Rees; Geoffrey Dowson Gripper; Thomas William Earl Moreton; Cyril Hamilton Phillips, M.D.; James Aspinall Marsden; Hubert Cyril Willoughley Allott; Alexander William Allan, M.D.; John Welsh; John Pender, M.B.; Hugh Miller, M.B.; Thomas Smyth, M.B.; William James Edgar; Frederick James Strachan, M.B.; Herbert Hargreaves, M.B.; Archibald Davidson, M.D.; Harold Edward Dyson, M.D.; Francis Percy Young, M.D.; David Kennedy, M.D.; Edward Hesterlow, M.B.; Arthur Lonsdale McCreery, M.B.; William Darlington, M.B.; Harold Oscar Gough; James Douglas Cooke, M.B., F.R.C.S.; Robert Graham Brown; George Herbert Simpson.

Dated December 2, 1915.—William Bow Tannahill, M.B.; Kenneth Pretty, M.B.; John Ross, M.D.; Oswald Vincent Burrows, M.B.

Dated December 4, 1915.—Alfred Tulloch Thompson, M.B.; Tom Stanbury Brook; Allan Barrett, M.B.; John Alexander Harper, M.B.; James Appleyard; Charles Henry Mossop; James Norman Jackson Hartley, M.B.; Basil Patrick Campbell, M.D.; F.R.C.S.Edin.; Colin Guy Hirst Campbell, M.B.; Charles Booth Jones, M.B.; Roland Sinclair, M.B.; William Leslie, M.B.; Matthew Wright Talbot, M.B.

Dated December 6, 1915.—John Francis Lambie, M.B.; Solomon David Bridge; Frank Whinfield Bartlett; Arthur Owen Evans, M.B.; Purser Davies, M.B.; James Gordon Bell, M.B.; Cecil Berry; Frederick Hugh Young; Augustin Pownall Fry, M.B.; Edward Purcell; Rupert Cecil Lowe, M.B.; Frederick Michael Bishop; James Arthur Venning, M.B.

Dated December 7, 1915.—Robert Archibald MacNeill, M.B.; Robert Townley Slinger, M.B., F.R.C.S.; Horace Mather; William Arthur Berry, M.D.; William Adam Paterson, M.B.; John Charles Wilson, M.B.; James Christopher Wadmore; William Hackett Broughton.

Dated December 8, 1915.—George Burns Salmond, M.B.; Raymond Brewitt Taylor, M.B.; John Tudor Griffiths; Daniel Colville Adam, M.B.; Philip Dennis Scott; Alexander Erskine Clark, M.B.; Herbert Andrew Watney, M.B.; William Bird Loveless; George Ellis.

Dated December 9, 1915.—Charles James Pentland, M.D.; John Thomas O'Boyle; Thomas Jones Lloyd, M.B.; Godfrey Russell Potter; Vyvyan Kendall Sadler; David Irving Anderson, M.B.

Dated December 10, 1915.—Harry Joseph Cooper, M.B.; William Thomson Brown, M.B.; George Kee; Everard Roney Grieveson, M.B.; William Joseph Spearing; George Adams MacFarland; John Clarke Mead, M.B., F.R.C.S.; James Milne Hermon, M.D.; Charles Dyson Holdsworth, M.D.; Henry Joseph Keane, M.D.; Charles William Julius Dunlop; William Joseph McLearn Baird, M.B.; William Hammond Hodgson, M.B.; John Christie Forbes; Horace Macaulay Mills, M.B.; Edward Wilfred Kirk, M.B.; Robert Milne Lang M.B.; John William Hilliard, M.D.

Dated December 11, 1915.—Ronald Campbell Cooke.

Dated December 12, 1915.—John Wesley Harvey.

The undermentioned temporary honorary Lieutenants to be temporary Lieutenants:—

Dated November 10, 1915.—Charles Carrick Brewis.

Dated November 15, 1915.—Allan Hawkins Morley; Thomas Walker Melhuish; William Durward Cruickshank, M.B.

The undermentioned to be temporary Honorary Lieutenants:—

Dated October 12, 1915.—Edward James Clark, M.B.

Dated October 14, 1915.—Charles Fellowes Maclachlan, M.B.

Dated October 19, 1915.—Robert Burns Eadie, M.B.

Dated October 21, 1915.—Thomas Chalmers Bowie, M.B.

Dated November 28, 1915.—William Edward Nickolls Dunn, M.B.

Dated November 29, 1915.—Philip Hewer Wells; Eric Gordon Dingley.

Dated December 1, 1915.—John Nissen Deacon, M.B.

Dated December 6, 1915.—George Charles Berg; Charles Hugh Colclough Byrne.

Dated December 8, 1915.—Lancelot George Jacob; Samuel Reginald Prall.

Dated December 9, 1915.—William Thomas.

Dated December 10, 1915.—Basil Graves; William Henry Marshall.

Dated December 25, 1915.—Henry Adrian Fitzroy Wilson.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated November 5, 1915,—Charles Edgar Wilson, M.B.; Harold Chester Sutton, M.B.; Henry Brown Moyle, M.B.; Harold Percival Rogers, M.B.; Alfred Westland Nixon, M.D.; Harry Blackett Stacpoole, M.D.

Dated November 9, 1915.—Captain Oscar Glennie Donovan, M.D.; Howe Alonzo Jones, M.D.; Lewis Mark Morton; Frederick Joseph Richardson Forster, M.B.; Loren Wilson May, M.D.; Thomas Clarence Routley, M.B.; Charles Leon Gass, M.D.

Dated November 11, 1915.—Albert Edward Sutton, M.B.; John Donald Stewart, M.D.; Thomas Fison Saunders, M.D.; Percy Weeks Barker, M.B.; Thomas Richard Phipps, M.D.; Ezra Newton Drier, M.D., F.R.C.S.Edin.; G. Wylie Carleton, M.B.; William Wilson Cruise, M.B.; Frederick Alexander Ross, M.B.; Edgar Harold McVicker, M.B.; Ambrose Bell Moffat, M.B.; Donald McEdwards Kilgour, M.B.; Vernon Elroy Cartwright, M.B.; Alan Ernest McKibbin; Donald Alexander Warren; William Arthur McLeod, M.D.; Edgar Shewell Bissell, M.D.; Clarence Randolph Young, M.B.; Ebenezer Bryceson; Thomas Patterson Devlin.

Dated November 13, 1915.—Captain Melville Hamilton Embree, M.B.; Gordon McIntyre Dale, M.B.; Gordon Archibald McLarty, M.B.; Stanley Arthur Walker, M.B.; Wallace Balfour Seaton, M.B.; Colin William MacRury, M.D.; William Ernest Dean, M.D.; Robert Home, M.B.; Andrew Rutherford Riddell, M.B.; George Crerar McIntyre, M.B.; John Grant Cunningham, M.B.; Robert Inkerman Harris, M.B.

Dated November 15, 1915.—John Russell Christian, M.B.; John Phelan MacDonald, M.D.

Dated November 19, 1915.—Joseph Jules Hamelin, M.D.; William Elliott Fraser, M.D.; Rolland Wilton Halladay, M.D.

Dated November 23, 1915.—Ralph Thomson MacLaren, M.D.: Edward Hiram Freeman, M.D.; Ernest Samuel Moorhead, M.B.; Alex Boyd Roberts; James Bryce Brown, M.B.; Charles Stuart Wynne, M.B.; Harry Whittaker Paddell, M.D.;

Ernest Rommel; James Douglas Shields, M.B.; Archibald Forbes Laird, M.D.; William Laurence Evans, M.B.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated August 24, 1915.—David Morrow.

Dated September 12, 1915.—Richard Bright.

Dated October 11, 1915.—James W. Littlejohn, M.D.

Dated October 24, 1915.—David H. Collingham.

Dated October 31, 1915.—Reginald W. Davies, M.B.; Alexander S. Allan, M.B.

Dated November 1, 1915.—Dudley G. Greenfield, M.D., F.R.C.S.; Archibald F. Wright, M.B.; Edward F. Palgrave; David J. M. Legge, F.R.C.S.Edin.; Reginald W. Davies, M.B.; Alexander S. Allan, M.B.

Dated November 9, 1915.—Henry V. Swindale.

Dated November 10, 1915.—William Wallace Woods, M.B.

Dated November 17, 1915.—Bernard Francis, M.D.

Dated November 25, 1915.—William H. Dye.

Dated November 28, 1915.—Thomas Perrin, M.D., F.R.C.S.

Dated December 1, 1915.—Donald J. G. Grant, M.B.

Dated December 5, 1915.—Robert W. Griffin.

Dated December 7, 1915.—Andrew R. Douglas.

Dated December 15, 1915.—Arthur H. Flannery, M.B.

Dated December 17, 1915.—George W. Clark, M.B.

Dated December 22, 1915.—John Hegarty.

The undermentioned temporary Lieutenants relinquish their commissions on account of ill-health:—

Dated December 12, 1915.—Alfred C. Warren, M.D.

Dated December 13, 1915.—Ninian E. M. Home-Hay, M.B., Ewan G. Cameron.

Dated December 16, 1915.—Horace P. W. White, M.B.

Temporary Honorary Lieutenant James P. S. Dunn, M.B., having ceased to serve with the British Red Cross Hospital, Netley, relinquishes his commission, dated December 6, 1915.

Temporary Captain Ernest F. W. Buckell relinquishes his commission on account of ill-health, dated December 18, 1915.

Major (temporary Lieutenant-Colonel) John G. Bell, M.B., relinquishes his temporary rank on vacating the appointment of Assistant Director of Medical Services, dated November 18, 1915.

Temporary Lieutenant-Colonel Sir Ronald Ross, K.C.B., F.R.S., F.R.C.S., relinquishes his commission, dated November 29, 1915.

Temporary Captain William P. Morgan, M.B., relinquishes his commission, dated December 2, 191.

The date on which temporary Quartermaster and Honorary Lieutenant Thomas Brina relinquished his commission is December 7, 1915, and not as stated in the *Gazette* of December 6, 1915.

To be Honorary Captain, Quartermaster and Hon. Lieutenant J. Wilson, R.A.M.C., dated November 2, 1915, *London Gazette*, November 23, 1915.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated November 15, 1915.—Ernest Harry Gann; George Ernest Town.

Dated November 16, 1915.—Alexander Edward Shaw.

Dated November 18, 1915.—Alfred William Ward; George Jackson.

Dated November 20, 1915—Abraham Allen.

Dated November 22, 1915.—William Arther Poucher.

Dated November 25, 1915.—Gilbert Arthur Sumner.

Dated November 27, 1915.—Edward Charles James Curling.

Dated November 29, 1915.—Edward Gane Inge.

Dated December 4, 1915.—Charles Francis Tyson.

Dated December 5, 1915.—Charles William Atkins.

Dated December 6, 1915.—Harry Miller.

Dated December 8, 1915.—Thomas Forcer Evans; Walter Richardson; Stanley Francis.

Dated December 10, 1915.—Thomas Henry Griggs; Frederick Leonard Harsant; Alfred Scates.

Dated December 11, 1915.—Walter Pearson; Noel Reeves Brown; George Frederick Norman Taylor; John Stone; Arthur Willden.

Dated December 13, 1915.—John Dodds; Edward Allsop Beattie.

Dated December 15, 1915.—John Henry Turner; Henry Maffey; James Davis.
Dated December 16, 1915.—Robert George Johnston; Joseph Flint.
Temporary Quartermaster and Honorary Lieutenant Thomas Brina relinquishes his commission on account of ill-health, dated December 17, 1915.

TERRITORIALS.

Royal Army Medical Corps.

1st Highland Field Ambulance.—Lieutenant John M. Chrystie to be Captain, dated November 21, 1915.

2nd Highland Field Ambulance.—Lieutenant Benjamin J. Alcock, M.B., to be Captain, dated October 1, 1915; Transport Officer and Honorary Lieutenant David H. Duthie is seconded for duty with 1st Provisional Brigade Field Ambulance, dated September 3, 1915.

3rd Highland Field Ambulance.—Lieutenant John G. Anderson to be Captain, dated May 1, 1915; Lieutenant Alexander R. Moodie, M.B., to be Captain, dated November 14, 1915; Lieutenant Alexander B. Jamieson, M.B., to be Captain, dated December 1, 1915.

Highland Casualty Clearing Station.—Lieutenant John Alexander Innes, M.B., to be Captain, dated December 3, 1915; Lieutenant John Dow, M.B., to be Captain, dated December 11, 1915.

1st Lowland Field Ambulance.—Lieutenant William B. Stewart, M.B., to be Captain, dated December 5, 1915.

2nd Lowland Field Ambulance.—Captain William A. Burns, M.B., to be Major, dated November 1, 1915; Charles Stuart Peddie Black, M.B. (late Lieutenant 6th Battalion, The Highland Light Infantry), to be Captain, dated November 24, 1915.

1st Northern General Hospital.—Lieutenant James D. Lickley, M.D., to be Captain, dated October 27, 1915; Lieutenant James A. Menzies, M.D., to be Captain, dated November 20, 1915; Lieutenant William A. Slater, M.B., to be Captain, dated December 1, 1915; Lieutenant Thomas S. P. Parkinson, M.B., to be Captain, dated December 7, 1915.

2nd Northern General Hospital.—The following announcement is substituted for that which appeared in the *London Gazette* of December 2, 1915: Lieutenant-Colonel Joseph Faulkner Dobson, M.B., F.R.C.S., is placed on temporary retired list on account of ill-health, dated December 3, 1915; Lieutenant-Colonel Harry Littlewood, F.R.C.S., from the list of officers whose services are available on mobilization, is temporarily placed on the permanent personnel, dated January 1, 1916; Lieutenant Harold D. Pickles, M.B., to be Captain, dated November 18, 1915.

2nd Northumbrian Field Ambulance.—Lieutenant Cecil D. Rogers, M.B., to be Captain, dated November 7, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of November 24, 1915: Captain Wilson H. Morrison, M.B., from Attached to Units other than Medical Units, to be Captain, dated November 25, 1915.

3rd Northumbrian Field Ambulance.—The undermentioned Lieutenants to be Captains: Robert Raffle, M.B., dated November 11, 1915; John Steedman, M.B., dated November 12, 1915.

1st North Midland Field Ambulance.—The undermentioned to be Lieutenants, dated November 24, 1915: David Ashley Wilson, M.B.; James Howard.

3rd North Midland Field Ambulance.—The following announcement is substituted for that which appeared in the *London Gazette* of October 22, 1915: Captain Arthur E. Tait, M.B., from 2nd East Anglian Field Ambulance, to be Captain, dated October 23, 1915; Lieutenant Crichton S. Lee to be Captain, dated November 12, 1915; Major Andrew E. Hodder, M.B., to be temporary Lieutenant-Colonel, dated November 26, 1915.

North Midland Mounted Brigade Field Ambulance.—The undermentioned Lieutenants to be Captains; Robert Hargreaves, dated November 4, 1915; William E. Kingdon, M.B., dated November 5, 1915.

1st South Midland Mounted Brigade Field Ambulance.—Lieutenant Frank Smith to be Captain, dated December 7, 1915; Lieutenant Edward P. Dawes, from Attached to Units other than Medical Units, to be Lieutenant, dated December 12, 1915.

2nd South Midland Mounted Brigade Field Ambulance.—Lieutenant William Vincent Wood to be Captain, dated December 14, 1915.

2nd South Midland Field Ambulance.—Lieutenant Walter M. Cox, from Attached to Units other than Medical Units, to be Lieutenant, dated September 28, 1915; Lieutenant Walter M. Cox to be Captain, dated October 29, 1915 (substituted for the announcement which appeared in the *London Gazette* of November 19, 1915, under the heading of "Attached to Units other than Medical Units").

3rd South Midland Field Ambulance.—Frederick Alexander James Mayes to be Lieutenant, dated December 3, 1915.

South Midland Divisional Sanitary Section.—Lieutenant William H. Davison, M.B., to be Captain, dated December 10, 1915.

South Midland Casualty Clearing Station.—Guy Hannah Kirby to be Lieutenant, dated December 21, 1915.

1st East Lancashire Field Ambulance.—Lieutenant Thomas Hayhurst, M.B., to be Captain, dated April 1, 1915. The date of promotion of Lieutenant Robert S. Young, M.B., to Captain is May 31, 1915, and not as stated in the *London Gazette* of October 1, 1915; Charles Wainwright Fort, M.B., to be Lieutenant, dated November 4, 1915; Major Stephen Nesfield, from Attached to Units other than Medical Units, to be Major, dated December 8, 1915; Norman Cecil Frye to be Quartermaster, with the honorary rank of Lieutenant, dated October 19, 1915; Lance-Corporal James Moore Lowe to be Quartermaster, with the honorary rank of Lieutenant, dated December 19, 1915.

3rd East Lancashire Field Ambulance.—Major Thomas Holt, M.D., from 3rd West Lancashire Field Ambulance, to be Major, dated January 1, 1916; Arthur William Berry, M.B., to be Lieutenant, dated November 16, 1915; Lance-Corporal Thomas Henry Calverley, from 26th Battalion, The Manchester Regiment, to be Quartermaster, with the honorary rank of Lieutenant, dated December 19, 1915.

East Lancashire Casualty Clearing Station.—Lieutenant Edward A. Williams to be Captain, dated November 1, 1915; Thomas William Leighton, M.B., to be Lieutenant, dated October 13, 1915; John William Cottrell to be Quartermaster, with the honorary rank of Lieutenant, dated October 18, 1915.

1st West Lancashire Field Ambulance.—Huntly Nevins Pelly (late Lieutenant, Royal Army Medical Corps, Territorial Force), to be Captain, dated December 5, 1915; Alan Hargrave Pinder to be Lieutenant, dated November 20, 1915; Transport Officer and Honorary Lieutenant James N. P. Holt resigns his commission, dated December 19, 1915.

2nd West Lancashire Field Ambulance.—The undermentioned Lieutenants to be Captains: James P. Thierens, M.B., dated October 28, 1915; William F. Young, M.B., dated November 9, 1915; Albert Victor Glendenning, M.B., to be Lieutenant, dated December 1, 1915; Quartermaster and Honorary Lieutenant James Bennett is seconded, whilst holding a temporary commission in the Army Service Corps, dated December 1, 1915.

3rd West Lancashire Field Ambulance.—Robert Findlay, M.B., to be Lieutenant, dated October 21, 1915; Norman McCall-Smith, M.D., to be Lieutenant, dated November 8, 1915.

West Lancashire Casualty Clearing Station.—Major (temporary Lieutenant-Colonel) Ernest W. Barnes, from 3rd West Lancashire Field Ambulance, to be Major, dated December 17, 1915; Major Ernest W. Barnes to be temporary Lieutenant-Colonel, dated December 17, 1915; Lieutenant Ronald K. Merson to be Captain, dated November 23, 1915; Duncan Francis Hunter, M.D., to be Lieutenant, dated November 5, 1915.

2nd West Riding Field Ambulance.—Herbert Arthur Beetham, M.B., to be Lieutenant, dated November 20, 1915.

Welsh Border Mounted Brigade Field Ambulance.—Captain John A. Eyton-Jones relinquishes his commission on account of ill-health, dated December 30, 1915; Transport Officer and Honorary Lieutenant Richard G. Cockrill resigns his commission on appointment to Army Service Corps, dated December 12, 1915.

2nd Wessex Field Ambulance.—The date of appointment of Captain Horace J. Pechell, M.B., is August 2, 1915, and not as stated in the *London Gazette* of October 1, 1915; Lieutenant Stanley R. Gibbs, from Attached to Units other than Medical Units, to be Lieutenant, dated December 26, 1915; Lieutenant Stanley R. Gibbs to be Captain, December 26, 1915.

3rd Wessex Field Ambulance.—The undermentioned to be Lieutenants, dated November 20, 1915: Frederick Joseph Mary Kennedy, Thomas Joseph Costello, M.B. Quartermaster and Honorary Lieutenant George D. C. Stokes resigns his commission, dated December 29, 1915.

Wessex Casualty Clearing Station.—Herbert John Furler to be Quartermaster, with the honorary rank of Lieutenant, dated December 5, 1915.

1st East Anglian Field Ambulance.—Serjeant Major Harry Gordon Aldiss, from 2nd East Anglian Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated December 7, 1915.

2nd East Anglian Field Ambulance.—Lieutenant Arthur E. Tait, M.B., to be Captain, dated June 15, 1915; Captain James Arthur, M.D., to be temporary Major, dated November 1, 1915; Lieutenant Savile J. Fielding, M.B., to be Captain, dated December 5, 1915.

East Anglian Casualty Clearing Station.—Lieutenant William J. Deighan to be Captain, dated October 30, 1915.

1st Eastern General Hospital.—Captain Wilson Tyson, M.D., is seconded for duty with the Duchess of Sutherland's Hospital, dated December 5, 1915.

2nd Eastern General Hospital.—Lieutenant Ernest F. Ballard, M.B., to be Captain, dated December 3, 1915.

2nd Western General Hospital.—Lieutenant Frank Chadwick, M.B., to be Captain, dated November 1, 1915; Richard Willan, M.B., to be Lieutenant, dated October 22, 1915; William Sankey, M.B., to be Lieutenant, dated November 1, 1915; Frank Hamilton Lacey, M.B. (late Lieutenant, East Lancashire Army Service Corps), to be Lieutenant, dated December 8, 1915.

1st Southern General Hospital.—Lieutenant Arthur H. Newton, M.B., to be Captain, dated November 14, 1915; Lieutenant Aubrey Radford, M.B., to be Captain, dated December 7, 1915; Thomas Sidney Stafford (late temporary Lieutenant, Royal Army Medical Corps) to be Lieutenant, dated October 18, 1915; Allan Nathaniel Worsley, M.B., to be Lieutenant, dated December 1, 1915.

2nd Southern General Hospital.—Captain James G. McLannahan, from 3rd South Midland Field Ambulance, to be Captain, whose services will be available on mobilization, dated December 17, 1915.

3rd Southern General Hospital.—The undermentioned Lieutenants to be Captains: Hugh A. B. Whitelocke, dated November 5, 1915; William Stobie, M.B., dated November 7, 1915.

4th Southern General Hospital.—The undermentioned Captains to be Majors, dated January 1, 1916: Charles E. Bean, F.R.C.S.Edin.; Frederick G. Aldous, F.R.C.S. Edin. Major Robert L. Rutherford, M.D., resigns his commission on account of ill-health, dated December 29, 1915.

5th Southern General Hospital.—John Edwin Ford Palser to be Captain, whose services will be available on mobilization, dated December 14, 1915. The undermentioned to be Captains, whose services will be available on mobilization, dated December 18, 1915: Bertram Alfred Wood Stone, M.B.; Arthur Ambrose Burrell, M.B.

2nd South Western Mounted Brigade Field Ambulance.—Lieutenant John H. Cumming to be Captain, dated December 7, 1915; James Woodman Astley Cooper to be Lieutenant, dated December 10, 1915.

1st Home Counties Field Ambulance.—Lieutenant Henry T. Jones, M.B., from 2nd Home Counties Field Ambulance, to be Lieutenant, dated May 3, 1915; Lieutenant Henry T. Jones, M.B., to be Captain, dated November 3, 1915; Lieutenant William T. Henderson, M.B., to be Captain, dated November 3, 1915.

2nd Home Counties Field Ambulance.—Lieutenant Benjamin A. Bull to be Captain, dated November 19, 1915; Captain Joseph E. Ryan, M.D., from 6th London Field Ambulance, to be Captain, dated December 29, 1914.

3rd Home Counties Field Ambulance.—Lieutenant Milward C. Hayward to be Captain, dated June 3, 1915; Lieutenant William W. Maxwell, M.D., to be Captain, dated November 11, 1915.

Home Counties Casualty Clearing Station.—Captain Richard W. Brimacombe, from Attached to Units other than Medical Units, to be Captain, dated December 1, 1915; Captain Douglas Hay Scott, M.B., from 3rd Highland Field Ambulance, to be Captain, dated December 11, 1915.

Home Counties Divisional Sanitary Section.—Frank Thomas Herbert Wood, M.B., to be Lieutenant, dated November 30, 1915.

1*st London* (*City of London*) *Field Ambulance.*—The date of promotion of Lieutenant Arthur D. Griffith, M.D., F.R.C.S., to Captain is April 1, 1915, and not as stated in the *London Gazette* of June 26, 1915; Eustace Norman Butler (late Captain, East African Medical Service) to be Lieutenant, dated November 19, 1915.

1*st London* (*City of London*) *Sanitary Company.*—Sydney Andrew Mann to be Lieutenant, dated November 22, 1915; Second Lieutenant James Davidson, from 7th (Service) Battalion, The Royal Irish Rifles, to be Lieutenant, dated December 5, 1915; Henry Duguid, M.B., to be Lieutenant, dated December 6, 1915; Robert Arthur Askins, M.D., to be Lieutenant, dated December 17, 1915.

2*nd London Sanitary Company.*—Lieutenant Arthur G. Whitfeild to be Captain, dated November 8, 1915; Lieutenant Frederick G. Rose to be Captain, dated November 20, 1915; Lieutenant Alfred C. Williams, M.B., to be Captain, dated November 25, 1915. The date of appointment of Lieutenant Kenneth B. Williamson is November 15, 1915, and not as stated in the *London Gazette* of November 26, 1915. Edgar Bernard Argles to be Lieutenant, dated December 10, 1915. The date of the appointment of Lieutenant Martin S. Briggs is December 4, 1915, and not as stated in the *London Gazette* of December 11, 1915. Martin Shaw Briggs to be Lieutenant, dated December 12, 1915; Sidney Langton Bartholomew to be Lieutenant, dated December 14, 1915; Doulgas Porter, M.B., to be Lieutenant, dated December 23, 1915.

2*nd London* (*City of London*) *General Hospital.*—Quartermaster-Serjeant Frederic John Edward Carter to be Quartermaster, with the honorary rank of Lieutenant, dated December 23, 1915.

3*rd London General Hospital.*—Lieutenant Lionel B. Clarke to be Captain, dated November 26, 1915; Lieutenant Lionel L. Preston, M.B., to be Captain, dated December 5, 1915; Lieutenant Charles H. J. Fagan to be Captain, dated December 16, 1915.

4*th London Field Ambulance.*—Captain (temporary Major) John R. Holmes, M.B., relinquishes his temporary rank on alteration in posting, dated September 22, 1915; Captain John R. Holmes, M.B., is seconded for duty with 20th Battalion, The London Regiment, dated October 4, 1915; Captain William Cowie, M.B., to be temporary Major, dated September 22, 1915; Olaf Gleeson to be Lieutenant, dated December 14, 1915.

5*th London General Hospital.*—Major (temporary Lieutenant-Colonel) Herbert P. Hawkins, M.D., from 2nd London General Hospital, to be Major, dated August 16, 1915; Major Herbert P. Hawkins, M.D., to be Lieutenant-Colonel on the permanent personnel, dated August 16, 1915; Captain Philip H. Mitchiner, M.B., F.R.C.S., from list of officers supernumerary for service with the Officers Training Corps, to be Captain on the permanent personnel, dated August 16, 1915.

The undermentioned to be Captains, whose services will be available on mobilization: Claude Gouldesbrough, M.B., dated August 16, 1915; John Prescott Hedley, dated August 16, 1915; Zebulon Mennell, M.B., dated August 16, 1915; Edred Moss Corner, M.B., F.R.C.S., dated August 16, 1915; Joseph Ebenezer Adams, M.B., F.R.C.S., dated August 16, 1915; Maurice Alan Cassidy, dated September 20, 1915; Herbert James Marriage, M B., F.R.C.S., dated September 20, 1915; Edward Farquhar Buzzard, M.B., dated September 20, 1915; Henry Bright Weir, dated September 20, 1915; Edward Williams Hedley, M.D., dated September 20, 1915.

The undermentioned to be Lieutenants, dated August 16, 1915: Harold Marsh Harwood; Henry Austin Philpot, M.D.

6*th London Field Ambulance.*—Quartermaster and Honorary Lieutenant William Ramsay, from 2nd London Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated December 7, 1915.

TERRITORIAL FORCE RESERVE.

Royal Army Medical Corps.

Captain Duncan C. L. Fitzwilliams, M.D., F.R.C.S., from 1st London (City of London) Field Ambulance, to be Captain, dated December 16, 1915.

Major (temporary Lieutenant-Colonel) William T. Blackledge, M.B., from 1st West Lancashire Field Ambulance, to be Major, dated January 1, 1916.

Territorial Force Nursing Service.

Miss Francis Water to be Matron, 2nd Eastern General Hospital, dated November 5, 1915.

SPECIAL RESERVE.

The date of the promotion of Lieutenant John Cameron, M.B., to the rank of Captain is antedated to April 1, 1915 (but not to carry Army pay or allowances prior to May 4, 1915), with seniority next below T. Warrington.

The undermentioned Lieutenants to be Captains:—

Dated November 1, 1915.—Ralph R. Thompson; Joseph H. Bayley; James Lawson, M.B.; Norman Graham, M.B.; Arthur E. Richmond.

Dated November 3, 1915.—Francis L. P. G. Bennett, M.B.; Patrick A. Clements, M.B.

Dated November 5, 1915.—Geoffrey B. Egerton, M.B.

Dated November 10, 1915.—Robert O. C. Thomson, M.B.; William Murdock, M.B.

Dated November 13, 1915.—David W. J. Andrews.

Dated November 17, 1915.—William J. Webster, M.B.

Dated November 27, 1915.—George G. Cooper, M.B.

Captain Samuel Wright is placed temporarily on Retired Pay on account of ill-health, dated September 19, 1915. (Substituted for the notification which appeared in the *Gazette* of September 18, 1915.)

Lieutenant Andrew C. Cassells, M.B., is placed temporarily on Retired Pay on account of ill-health, dated December 5, 1915.

The undermentioned Lieutenants (on probation) are confirmed in their rank: John B. Cavenagh: Matthew J. Graham, M.B.; William H. A. D. Sutton; William W. S. Sharpe.

Cadet Serjeant Thomas Reginald Davies, University of London Contingent, Officers Training Corps, to be Lieutenant (on probation), dated November 23, 1915.

Attached to Units other than Medical Units.

Lieutenant Gerald Stephen Hughes, M.B., F.R.C.S., to be Captain, dated August 10, 1914.

Lieutenant William R. Collingridge to be Captain, dated April 1, 1915.

Lieutenant George S. Glass, M.B., to be Captain, dated April 1, 1915.

Lieutenant Charles C. Fitzgerald to be Captain, dated April 1, 1915.

Lieutenant Wilson H. Morrison, M.B., to be Captain, dated April 5, 1915.

Lieutenant Hugh D. McCrossan, M.B., to be Captain, dated May 9, 1915.

Lieutenant George J. E. Trotter to be Captain, dated September 19, 1915.

The date of appointment of Major Arthur B. Harris, M.B., is October 2, 1915, and not as stated in the *London Gazette* of November 22, 1915.

Alfred Lang Bodley to be Lieutenant, dated October 22, 1915.

Lieutenant John E. Ransford to be Captain, dated October 26, 1915.

John Peter Clarke to be Lieutenant, dated November 20, 1915.

Lieutenant Charles B. Alexander to be Captain, dated November 22, 1915.

Thomas Ernest Saunt to be Lieutenant, dated November 25, 1915.

James Burnet Smith, M.B., to be Lieutenant, dated November 25, 1915.

James Ernest Studholme Wilson to be Lieutenant, dated December 4, 1915.

George Charles Walker, M.D., to be Lieutenant, dated December 7, 1915.

Frank Walter White to be Lieutenant, dated December 12, 1915.

Fred Newton Walsh to be Lieutenant, dated December 12, 1915.

James Morrison Orr, M.D., to be Lieutenant, dated December 17, 1915.

Lieutenant-Colonel Robert Campbell Highet, M.D., Retired List, Territoral Force (late Fourth Royal Garrison Artillery), to be Major, dated December 18, 1915.

Captain William G. Macfee to be Major, dated December 4, 1915.

Frank Mainwaring Hughes to be Lieutenant, dated January 4, 1916.

Edward Meyer de Jong to be Lieutenant, dated January 4, 1916.

Sanitary Service.

Andrew Norris Stevens to be Captain, whose services will be available on mobilization, dated December 8, 1915.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF OCTOBER, NOVEMBER AND DECEMBER, 1915.

Title of Work and Author	Edition	Date	How obtained
The Elements of Physical Chemistry. By J. L. R. Morgan	5th	1914	Library Grant.
Review of the Work of Donders. By Ernest Clarke		1914	,, ,,
Flies in Relation to Disease: Blood-sucking Flies. By Edward Hindle, B.A.		1914	,, ,,
Medical Jurisprudence for India. By Lyon and Waddell	5th	1914	Editor, Journal.
John Shaw-Billings; a Memoir. By F. H. Garrison, M.D.		1915	,, ,,
On Pharmaco-therapy and Preventive Inoculation applied to Pneumonia in the African Native. By Sir A. E. Wright, M.D., F.R.S.		1914	,, ,,
Nerve Injuries and Shock. By Captain W. Harris, M.D., R.A.M.C.(T.)		1915	,, ,,
The Stretcher Bearer. By G. M. Dupuy, M.D. ..		1915	,, ,,
Contribución al Estudio del Bacilo Fusiforme y de sus Manifestaciones. Por el Doctor A. Ramisez Santaló		1915	,, ,,
Guy's Hospital Reports. Vol. lxviii. 1914 ..		1915	,, ,,
A Manual of Physiology. By G. N. Stewart, M.A.	7th	1914	,, ,,
Modern Chemistry and its Wonders. By Geoffrey Martin, D.Sc.		1915	,, ,,
Cerebrospinal Fever. By T. J. Horder, M.D. ..		1915	,, ,,
A Guerra E. O. Pensamento Medico. By Ricardo Jorge		1915	,, ,,
Kriegschirurgische Hefte der Beiträge zur Klinischen Chirurgie. P. v. Bruns. Bd. xcvii, Heft 5		1915	War Office.
Reflexions sur la Chirurgie de l'Extrême-Front. Par Dr. Jean Bouchon		1915	Lt.-Col. Barrow, R.A.M.C.
La Thoracoscopie. Par Dr. Jean Bouchon ..		1915	,, ,,
La Segmentoscopie. Par Dr. Jean Bouchon ..		1915	,, ,,
La Cephaloscopie. Par Dr. Jean Bouchon ..		1915	,, ,,
L'Organoscopie. Par Dr. Jean Bouchon ..		1915	,, ,,
L'Organoscopie Abdominale. Par Dr. Jean Bouchon		1915	,, ,,
The British Journal of Surgery. Vol. i		1913-14	Presented by Lt.-Col. Pilcher, D.S.O., R.A.M.C.
Report on Cerebrospinal Fever in the Royal Navy (August, 1914, August, 1915). By Temporary Surgeon-General Rolleston, M.D.		1915	Presented by the Author.
The Order of the Hospital of St. John of Jerusalem and its Grand Priory of England. By H. W. Fincham		1915	Presented by Lt.-Col. G. E. Twiss, R.A.M.C.

List of Books Left to the Library by Colonel W. Johnston, C.B.

Journal of the Royal Army Medical Corps. Vols. i. to xxiii. (bound in red calf), 1903—1914.

Army Circulars. 1867 to 1887.

Army Orders. 1867 to 1887.

General Orders. 1888 to 1900.

Army Dress Regulations. 1822, 1831, 1874, 1883, 1891, 1894, 1900, 1911.

Royal Warrant for the Pay and Non-effective Pay of the Army. 1878, 1881, 1882, 1887, 1890 to 1900, 1906, 1907, 1909, 1913.
Index of Army Forms. 1880, 1883, 1886, 1889.
Regulations and Instructions for Guidance of Officers of the Purveyors' Department. 1861.
Army Medical Department Report. 1890, 1901, 1907.
The Army Act. 1881. Ditto, ditto. 2nd Edition. 1882.
Notes on Service in War. By W. H. Macnamara.
Guide to Meat Inspection.
Trumpet and Bugle Sounds. 1883.
Manual of Volunteer Medical Service.
Field Service Manual. 1908, 1913.
Field Army Establishments. "Home Defence." 1890.
War Army Establishments. 1907-1908.
War Office List. 1891, 1900, 1912.
Army Medical Officers' Manual upon Active Service. By J. G. V. Millingen, M.D. 1819.
Army Book for the British Empire. By Lieutenant-General Goodenough. 1893.
Manual for the Medical Staff Corps. 1885, 1893, 1894.
Infantry Drill. 1889, 1892, 1893.
Infantry Training. 1902.
Manual for R.A.M.C. Training. 1899, 1904, 1908, 1911.
Manual of Instructions for Army Hospital Corps. 1875.
Manual of Exercises. By Sandford Moore.
The Soldiers' Pocket-book. 1886.
Financial Instructions in Relation to Army Accounts. 1886.
Voluntary Aid Training. 1911.
List of Changes in War Material. 1889.
Army Medical and Army Hospital Regulations. 1873.
Army Hospital Regulations. 1878.
Medical Regulations. 1863, 1878, 1885, 1890, 1896, 1897, 1900, 1906.
General Regulations and Orders for the Army. 1811, 1822.
A Collection of Regulations, Orders and Instructions. 1788, 1807.
Royal Warrants, Circulars, General Orders and Memoranda, August, 1856, to November, 1866. Classified by Major J. M. Bannatyne. 2nd Edition. 1866.
Our Services under the Crown. By A. A. Gore. 1879.
Manual of Ambulance Transport. By Sir T. Longmore. 2nd Edition. 1893.
Manual of Instructions for the Guidance of Army Surgeons in Testing the Vision of Recruits. By Surgeon-General T. Longmore, C.B. 2nd Edition. 1875.
Duties of a Regimental Surgeon. By R. Hamilton. 2 vols. 1787.
Notes of a Professional Life. By W. Ferguson. 1846.
Catalogue of Naval and Military Books. Edwards. 1907-1908.
Territorial Force Regulations. 1910.
Army Orders. 1901.
Manual of First Aid. By Scott Riddell. 2nd Edition. 1893.
Regulations for the Equipment of the Army. 1914.
Guide to Medical Officers on Field Service. By Major Edge, R.A.M.C. 1904.
Manual for Army Medical Services. By Surgeon-Major W. E. Riordan. 1890.
Mobilization Instructions. A.M.S. (Provisional Issue). 1899.
Evatt. On Bearer Company.
Regulations for Military Hospitals in the Peninsula. 1813.
List of Military Terms. 1912.
Army Medical Department Standing Orders. 1878, 1894, 1896, 1899, 1903.
Army Discipline Act. 1879.
Volunteer Medical Staff Corps Manual. 1892.
Regulations, Field Forces, South Africa. 1881.
Instructions for the Volunteer Forces of the Transvaal. 1879.
Subject List of Works on Naval and Military Acts. 1907.
A Treatise on Military Finance. 1795.
Manual of Dress and Equipment of Medical Services. 1893.
Ambulance Organization and Medical Arrangements of an English Army Corps in the Field. By Surgeon-Captain C. J. Addison, A.M.S. 1891.
A.M.D. Pamphlets. 1883-1901.
Succession of Field Officers.
Three old MS. Books, being Letters and Reports, etc., of Medical Services in the Peninsular War.

Letter-book of the Bearer Company, South Africa, 1881-1882, under Surgeon-Major W. Johnston.

Book of Orders of the Bearer Company, South Africa, 1881-1882, under Surgeon-Major W. Johnston.

Queen's Regulations and Orders for the Army. 1873, 1881, 1883, 1885, 1889, 1892, 1895, 1898, 1899, 1901.

King's Regulations and Orders for the Army. 1904, 1908, 1912.

Kane's List of Officers Royal Artillery, Revised. 1716-1869.

British Red Cross Report on South African War. 1902.

South African War Commission:—

(1) Minutes of Evidence. 2 vols.
(2) Report.
(3) Appendices.

Reports of Various Committees on the Army Medical Service. 1878-90.

Report of Select Committee of the House of Commons on the Medical Department of the Army. 1856.

Report of Royal Commission on Sanitary Condition of Army and Organization of Military Hospitals, etc., etc. 1858.

Committee on Medical Officers of Army and Navy. 1866.

Report of Committee on Army Hospital Services. 1883.

Royal Commission on South African Hospitals. 1901.

Fifth Report of the Commissioners of Military Inquiry. 1808.

Pamphlets, Papers, etc.

Introductory Lecture on the Rise and Progress of Rational Medical Education in Bengal. By Surgeon-Major Eatwell. 1875.

The Medical Department in the Field. By Surgeon-Major Marston, M.D.

The Secocoeni War. 1878-1879. By Captain Lacon Harvey.

On the Prevalence of certain Zymotic Diseases in the Army in 1887. By Sir T. Crawford, K.C.B. 1889.

Sur une Forme de Fièvre, etc. Par le Chirurgien Capt. M. L. Hughes. 1893.

Notizie e Considerazioni, etc. By Dr. Louis W. Sambon. 1892.

The Medico-Military Arrangements of the Japanese Army in the Field. By Surgeon-Colonel W. Taylor, M.D. 1895.

The Differential Diagnosis of Typhoid Fever. By Major Fred Smith, D.S.O. 1904.

Netley. By Colonel Kenneth MacLeod, M.D., LL.D., I.M.S. 1906.

The Role of the Red Cross Societies in Peace and in War. By Lieutenant-Colonel W. G. Macpherson, C.M.G., R.A.M.C. 1907.

Lecture on Removal of Sick and Wounded from the Battlefield. By Lieutenant-Colonel W. G. Macpherson, C.M.G., R.A.M.C. 1908.

Military Surgery. By Miles. 1907.

Manual of Chiropody. By M. L. Hughes. 1907.

Proposal to form a Corps of Volunteer Female Nurses. By Surgeon-Major G. J. H. Evatt, M.D., A.M.D.

The Truth about the Royal Army Medical Corps. By Surgeon-General G. J. H. Evatt. 1901.

Suggestions for the Improved Organization of the Medical Service of the Volunteer Forces. By Surgeon-General G. J. H. Evatt, C.B. 1904.

Regulations for the Officers Training Corps. 1909.

Regulations for General Hospitals of the Territorial Force. 1912.

Army Order, Special. March 18, 1908. Organization, etc., etc.

Army Order, Special. March 18, 1908. Scheme of the Transfer, etc., etc.

Army Order, Special. March 20, 1908. Transfer of Units, etc.

A Suggestion for Field Sanitary Study. By Brigadier-Surgeon A. A. Woodhull, U.S.A.

Direct Responsibility for Military Health and Sanitation. By Brigadier-Surgeon A. A. Woodhull, U.S.A.

Royal Army Medical College,
January 3, 1916.

ROYAL SCHOOL FOR DAUGHTERS OF OFFICERS, BATH.

Mrs. T. McCulloch wishes to thank all the Corps and Royal Army Medical Corps officers for their kind interest and votes for her daughter at the December election for the Royal School for Daughters of Officers, Bath, and to ask that they will kindly continue to vote for her at the June election, for though she got the large number of 2,020 votes she was not successful in getting into the School, but trusts she may next time with their kind help.

BIRTH.

MACKENZIE.—On November 18, 1915, at The Glen, Darjeeling, India, to Major and Mrs. J. Mackenzie, R.A.M.C., a daughter.

DEATHS.

LAND.—Brigade-Surgeon James Land, M.D. (retired), died at 27, Courtfield Gardens, Kensington, S.W., on December 31, 1915.

MORPHEW.—Surgeon-Major Augustus Morphew (retired), Army Medical Service, died at Mundesley, R.D. District Erpingham, County of Norfolk, on November 29, 1915.

WIGHT.—Lieutenant-Colonel Ernest Octavius Wight, R.A.M.C. (R.), Colonel, killed in action, December 19, 1915.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

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	16	0 13 3	0 5 10				
	4	0 6 0	0 3 1				
100	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
	4	0 9 6	0 4 5				
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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Colonel S. F. Clark, Colonel H. N. Thompson, Colonel A. H. Tubby, Lieutenant-Colonel R. J. Blackham, Lieutenant-Colonel H. W. Webber, Major N. Bardswell, Major J. H. Douglass, Major C. W. Duggan, Major E. G. Ffrench, Major M. Sinclair, Captain R. G. Abercrombie, Captain H. M. Anderson, Captain N. S. L. Barlow, Captain W. Bernard, Captain E. Brooke-Pike, Captain H. Carlton, Captain G. L. Eastes, Captain H. N. Good, Captain R. Kennon, Captain V. E. Negus, Captain P. T. Priestley, Captain G. Sichel, Captain E. H. Udall, Lieutenant W. E. Cooke, Lieutenant E. L. Horsburgh, Lieutenant W. MacAdam, Lieutenant H. L. C. Noel, Lieutenant P. Rendall, Lieutenant W. Wallace, Lieutenant T. H. Whittington, H. D. Dakin, Esq., J. A. Shaw-Mackenzie, M.D., C. Hamilton Whiteford.

The following publications have been received:—

British: St. Bartholomew's Hospital Journal, The Medical Journal of Australia, The Hospital, Tropical Diseases Bureau, The Sanitary Record of Municipal Engineering, The Lancet, The Medical Review, The Journal of Tropical Medicine and Hygiene, Transactions of the Society of Tropical Medicine and Hygiene, The Indian Journal of Medical Research, The Medical Journal of South Africa, Proceedings of the Royal Society of Medicine, Medical Press and Circular, Public Health, Guy's Hospital Gazette, The Middlesex Hospital Journal, The Red Cross Work of the St. John Ambulance Association, The Indian Medical Journal, Bulletin of Entomological Research, The Practitioner, The St. Thomas's Hospital Gazette, The Indian Medical Gazette, Red Cross and Ambulance News.

Foreign: Tidskrift i Militär Hälsovard, Le Caducée, Russian Naval Medical Journal, Memorias do Instituto Oswaldo Cruz, The Military Surgeon, Militaerlargen, Bulletin de l'Institut Pasteur, Bulletin of the Johns Hopkins Hospital, Revista de Sanidád Militar, Norsk Tidsskrift fur Militaermedicin, Bulletin de la Société de Pathologie Exotique, The Philippine Journal of Science, September, 1914.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

February, 1916.

EXTRACT FROM THE "LONDON GAZETTE," JANUARY 21—22, 1916.

His Majesty the King has been graciously pleased to award the Victoria Cross to the undermentioned man:—

No. 9730 Private John Caffrey, 2nd Battalion, the York and Lancaster Regiment.

For most conspicuous bravery on November 16, 1915, near La Brique. A man of the West Yorkshire Regiment had been badly wounded and was lying in the open unable to move, in full view of and about three hundred to four hundred yards from the enemy's trenches. Corporal Stirk, Royal Army Medical Corps, and Private Caffrey at once started out to rescue him, but at the first attempt they were driven back by shrapnel fire. Soon afterwards they started again under close sniping and machine-gun fire, and succeeded in reaching and bandaging the wounded man, but, just as Corporal Stirk had lifted him on Private Caffrey's back, he himself was shot in the head. Private Caffrey put down the wounded man, bandaged Corporal Stirk and helped him back into safety. He then returned and brought in the man of the West Yorkshire Regiment. He had made three journeys across the open under close and accurate fire and had risked his own life to save others with the utmost coolness and bravery.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned Officer to be Companion of the Distinguished Service Order, in recognition of his gallantry and devotion to duty in the Field:—

Captain Alexander Findlater, M.D., 1st London Mounted Brigade Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty on several occasions, notably on September 29, 1915, at Chocolate Hill, Gallipoli Peninsula. He crossed over two hundred yards of open ground under very heavy shell fire to render aid to two wounded men. He saved the life of one, but the other was beyond help.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officer, in recognition of his gallantry and devotion to duty in the Field:—

Temporary Lieutenant John Wesley Gilbert, Royal Army Medical Corps (attached 9th Brigade, Royal Garrison Artillery).

For conspicuous gallantry and devotion to duty near Ypres on December 29, 1915. After three attempts he succeeded in entering a farm, which was being heavily shelled with gas and other shells, and rendered valuable assistance to the wounded infantry who were billeted there.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Warrant Officers, Non-commissioned Officers and man for acts of gallantry and devotion to duty whilst serving with the Expeditionary Forces in France and Flanders, the Dardanelles, Mesopotamia, and East Africa:—

1568 Corporal W. G. Muir, 1/4 London Mounted Brigade Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty on several occasions, notably at Chocolate Hill, Gallipoli Peninsula, on September 29, 1915, when he crossed over two hundred yards of open ground under very heavy fire to assist the medical officer to render aid to two wounded men.

2167 Corporal A. J. Stirk, Royal Army Medical Corps (attached 2nd Battalion, York and Lancaster Regiment).

For conspicuous gallantry and devotion to duty near La Brique on November 16, 1915, when, with Private Caffrey, of the 2nd York and Lancaster Regiment, he rescued a wounded man who was lying far out and in full view of the German trenches. The first time they were driven back by shrapnel fire, but succeeded at the second attempt, though heavily fired on by snipers and machine-guns. Corporal Stirk was wounded in the head. He has done consistent good work throughout the campaign.

6220 Private J. S. Kerr, Royal Army Medical Corps (attached 7th Siege Battery, Royal Garrison Artillery).

For conspicuous gallantry and devotion to duty on December 29, 1915, near Ypres. During a heavy bombardment by high explosive and gas shells, he left his dug-out and passed through a dense cloud of gas over two hundred yards to a farm in which another battery was billeted. Here he rendered first aid to several wounded men. The farm was being heavily shelled at the time, but though wounded himself he continued his work among the other wounded.

ARMY MEDICAL SERVICE.

Colonel George D. Hunter, D.S.O., to be temporary Surgeon-General whilst a Director of Medical Services, dated December 23, 1915.

Colonel Edward H. L. Lynden-Bell, C.B., is retained on the Active List under the provisions of Articles 120 and 522, Royal Warrant for Pay and Promotion, and to be supernumerary, dated December 18, 1915. (Substituted for the notification which appeared in the *Gazette* of December 17, 1915.)

The undermentioned Lieutenant-Colonels to be temporary Colonels, whilst Assistant Directors of Medical Services:—

Dated July 4, 1915.—Frederick J. Greig.
Dated November 10, 1915.—Ferberd R. Bushwell.
Dated December 6, 1915.—Percy Evans, C.M.G., M.B.
Dated December 7, 1915.—Joseph F. M. Kelly, M.B.

ROYAL ARMY MEDICAL CORPS.

The date on which Major (temporary Lieutenant-Colonel) John G. Bell, M.B., relinquishes his temporary rank is November 16, 1915, and not as stated in the *Gazette* of December 22, 1915.

Major William M. B. Sparkes to be temporary Lieutenant-Colonel whilst Acting Assistant Director of Medical Services of a Division, dated November 20, 1915.

Harold Wilson Bruce, M.D., F.R.C.S., to be temporary Major whilst employed at the Southwark Military Hospital, dated November 1, 1915.

Charles Morley Wenyon, M.B., to be temporary Lieutenant-Colonel, dated January 1, 1916.

Temporary Honorary Major Mervyn H. Gordon, M.D., to be temporary Honorary Lieutenant-Colonel, dated January 11, 1916.

The undermentioned temporary Captains to be temporary Majors:—
Dated January 12, 1916.—William S. Dickie, F.R.C.S.
Dated January 14, 1916.—Robert J. D. Irvine, M.B.

The undermentioned temporary Lieutenants to be temporary Captains:—
Dated August 7, 1915.—Leonard C. Somervell.
Dated August 8, 1915.—James La F. Lauder.
Dated September 3, 1915.—William Ormsby.

Dated September 13, 1915.—Lieutenant Wilfred Parsons.

Dated October 10, 1915.—Ernest W. Adcock, M.B.; Archie R. Fraser, M.B.

Dated October 12, 1915.—Lionel P. Costobadie.

Dated November 10, 1915.—Alfred H. James; Robert C. Robertson, M.B.

Dated November 21, 1915.—Stephen G. Askey, M.B.

Dated December 1, 1915.—John M. Clements, M.D.; William H. Neil; Harold Dunkerley; Harry F. G. Noyes, M.B.; Bartholomew J. Mullin; Ralph M. Soames, M.B.; William A. Troup, M.B.; Claude H. Mills; Meredith Ffoulkes; John N. Griffiths, M.B.; Charles H. Harbinson, M.B.; John H. Wilson; Robert W. Willcocks, M.B.; Neil I. Sinclair, M.B.; Walter S. Evans; Henry M. Joseph, M.B.; Tobias R. H. Blake, M.B.; Oscar P. N. Pearn; John A. N. Scott, M.B.; John F. McG. Sloan, M.B.; David R. Williams; Herbert H. Whaite, M.B.; Thomas I. Bennett, M.B.; Hugh B. Waller; James J. Dwyer; Timothy Meagher, M.B.; Alexander H. R. Duncan: William B. Davy; John Hanson, M.B.; Walter E. Adam, M.D.

Dated December 2, 1915.—Robert D. Forbes, F.R.C.S.; Reginald H. Lucas; Alexander W. Rattrie; Eslyn Marjoriebanks-Marcar; Robert B. Roe; Frank Garratt; David D. Logan, M.D.; James E. M. Brown, M.B.; Luke S. O'Grady; Edward E. Mather, M.B.; John A. Cameron, M.B.; John Jardine, M.D., F.R.C.S.Edin.; Robert S. Miller, M.D.; Wilfred McFarlane, M.B.; James T. Kirkland, M.B.; Hubert A. Harris.

Dated December 4, 1915.—Michael P. Power; Herbert H. Prentiss, M.B.; James V. Fiddian; John A. K. Brayton; Leonard W. Mortimer; Cecil L. Williamson; Cuthbert E. Dukes, M.B.; John M. Land; Wilfred H. Alderton; Bertie R. G. Russell, M.D.; William E. Bullock, M.D.; Hugh R. Macintyre, M.D.; Humphrey M. Stephenson; Arthur L. H. Rackham; Norman F. Graham, M.B.; Alexander B. Cluckie, M.B.; John MacArthur; Harry M. Gilmour; William H. Brodie, M.B.; Henry Caplan, M.B.

Dated December 5, 1915.—Alfred C. Edwards.

Dated December 6, 1915.—Maurice H. Whiting, M.B.; Colin King, M.B.: Donald Duff, F.R.C.S.Edin.; Frank Hartley, M.B.; Thomas E. Amyot, M.B.; Frederick W. Hird, M.B.; James R. Rigg, M.B.; Walter J. Ronan, M.B.; Edward J. Stubbs, M.B.; Henry H. White, M.D.; Cyril G. Whorlow; Ernest L. Shelton-Jones.

Dated December 7, 1915.—Lewis A. Walker, M.D.; Ernest P. Chennells; Reginald Sherman, M.B.; Archibald L. George; John McA. Hill, M.B.; Joseph S. English, M.B.; Frank A. Murray, M.D.; Montgomery Du B. Ferguson, M.D.; Frederick R. Dougan, M.B.; Ignatius A. Dowling; Samuel Campbell, M.B.; John C. P. Bayley; George W. Fleming; Frederick Paine, M.D.; William J. G. Gayton; Norman Booth, M.B.; John N. Dobbie, M.B.; Sydney G. Billington, M.B., F.R.C.S.Edin.

Dated December 8, 1915.—James A. Hendry, M.B.; Frank A. Cooke, M.D.; Arthur J. O. Wigmore, M.B.; Edwin C. A. Smith; John W. C. Gunn, M.B.; Henry Thwaites; Leonard D. Saunders; Stuart Murray, M.B.: James Craig, M.B.; Ernest D. Wortley; Thomas Duncan; John Lumb, M.B.; John D. Harmer, M.B., F.R.C.S.; Carl J. B. Buchheim, M.B.; J. A. Ireland.

Dated December 9, 1915.—Arthur V. Stocks, M.B.

Dated December 10, 1915.—James R. Kemp; Guy Matthews, M.B.; James D. C. Swan, M.B.; Vincent J. Lawless; William L. Hodge; Arthur V. J. Harrison, M.B.; Robert M. Greig, M.B.; Douglas H. D. Wooderson, M.B.; Clare O. Stallybrass, M.D.; Patrick J. S. O'Grady, M.B.; Richard C. Monnington, M.D.; Thomas B. McKendrick; Sydney J. Simpson, M.B., F.R.C.S.Edin.; William H. Steele, M.B.; Victor Vesselovsky.

Dated December 11, 1915.—William Morris; Cecil A. Boyd, M.D.; Noel R. Rawson, M.B.; David H. Paul, M.D.

Dated December 12, 1915.—Carl R. B. von Braun; Arnold C. S. Courts, M.D.; Edwin L. Z. Fickling; Frederick S. Rowland.

Dated December 14, 1915.—James McK. Ferguson; Martin Hallam; Stephen Nockolds, M.B.

Dated December 15, 1915.—William Brown, M.B.; Wilfrid R. Pagen; Herbert P. Shackleton, M.B.; Archibald H. M. Robertson, M.B.; Henry Harold Scott, M.D.; James Harris Connolly, M.D., F.R.C.S.

Dated December 16, 1915.—Rhys V. Powell; James Jack, M.B.; Edward S. Johnson, M.D.; William J. Henry, M.B.; Harold Wacher, M.B.; Erskine H. Worth: Herbert R. Ford, M.B.; John B. Low, M.B.; Alexander Mearns, M.B.; Walter W. Hallchurch, M.B.; Edward S. Chapman, M.D., F.R.C.S.Edin.; Matthew J. Johnston, M.B.; Robert B. Jackson; Francis J. O. King, M.B.; Edward P. H. Vickery,

M.B.; Eric A. Lumley, M.B.; John G. Moseley; William E. Graves; Oswald A. Gee, M.B.; George MacLeod, M.B.; James J. Sinclair, M.B.; Samuel B. B. Campbell, M.B.; David H. Griffiths; David W. Jones; William F. Gibson, M.B.; John Allan; George E. Genge-Andrews; John W. Grice; John H. H. Pearson, M.D.

Dated December 18, 1915.—Edward L. Middleton, M.B.; Samuel Lyle, M.B.; John Lee, M.D.; Edward E. Hobson, M.B.; Leslie E. Pimm; Geoffrey R. Heard; John B. McCabe, M.B.; Evan Evans, M.B.; Edmund C. Fawcett, M.B.; John Chisholm, M.B.; Philip H. Rawson; George Richardson, M.D.; William G. Thompson, M.D., F.R.C.S.Edin.; James S. Hall, M.B.; Hugh L. Apthorp, M.D.; Edward Forbes, M.B.

Dated December 19, 1915.—Harold C. Godding; Marsham A'Beckett McCarthy.

Dated December 20, 1915.—Francis G. Crookshank, M.D.; Alfred G. Caldwell, M.D.; Alexander E. A. Burkhard.

Dated December 21, 1915.—Thomas J. Burton, M.D.; Geoffrey B. Richardson; Robert J. Jones; William Miller, M.D.; Harry G. Massey-Miles; Arthur G. G. Plumley, M.B.; Kenneth D. Bean, M.B.; Philip J. A. Seccombe, M.B.; William S. Dickie, F.R.C.S.; Joseph Graham, M.B.; Edward W. Lawrence, M.B.; George Pirie, M.B.; Kenneth G. Hearne, M.B.; Percival Butler; Alexander C. W. Knox, M.B.; Albert E. S. Martin, F.R.C.S.I.; Charles Sand, M.B.; Herbert H. Raw; George L. Brunton, M.D.; Robert P. McDonnell, F.R.C.S.I.; Roland H. Fletcher.

Dated December 22, 1915.—Donald O. Riddel; Arthur W. S. Christie, M.B., F.R.C.S.Edin.; James E. Cook, M.B.; Francis De S. McMenamin, M.B.; Miles Bracewell Arnold, M.D.

Dated December 23, 1915.—Leslie C. Johnston; George Mitchell, M.D.; Archibald Langwill, M.B.; Lacey Bathurst, M.B.

Dated December 24, 1915—John Warwick.

Dated December 28, 1915.—Robert A. S. Sunderland; Mortimer Hynes, M.B.; Norman G. Thornley, M.B.; James S. Martin, M.D.; Robert McL. Veitch, M.D.; Edward Mansfield, M.B.; David C. Hanson, M.B.; William De M. Peyton, M.B.; Martin M. Cruickshank, M.B.; Harold J. Pickering; David Haig; Alan E. Taylor, M.B.; Edgar C. Myott, M.D.; Harry Stanger; Hugh Faulkner, M.D.; James Allison, M.B.; James Gaston, M.B.; Cyril C. C. K. White; Jerome I. O'Sullivan, M.B.; Henry W. Turner.

Dated December 30, 1915.—Alexander K. Cosgrave, M.B.; William N. Watson, M.B.; Leslie D. Roberts, M.B.; Samuel R. Richardson, M.D.; Harry H. Carter, M.B.

Dated December 31, 1915.—Hubert C. Mulkern; Francis O'Neill; George T. Mowat, M.B.; Mortimer H. Pearson, M.B.; John S. Martin; John Gibson, M.B.; Ronald B. Macfie, M.B., F.R.C.S.Edin.

Dated January 1, 1916.—Robert G. Brown; William H. Clements; James D. Driberg, F.R.C.S.; Ernest L. M. Hackett.

Dated January 2, 1916.—Conwy L. Morgan, M.D.

Dated January 3, 1916.—Norman P. L. Lumb; Dawson C. Robertson, M.B.

Dated January 4, 1916.—Ralph A. Hughes, M.D.; Arthur H. Greg, M.B., F.R.C.S.

Dated January 5, 1916.—James E. Rutherford, M.B.

Dated January 7, 1916.—Andrew Grant, M.B.; George D. Sherwood; Albert E. Hodgson, M.D.; John Lang, M.B.; Harold B. Day, M.D.; Thomas B. Marshall, M.B.; Daniel Brough, M.B.; Thomas L. Butler; George F. Darker, M.D.; Howard G. Pesel, M.D.

Dated January 8, 1916.—Henry P. Harpur, M.B.; James Fettes, M.B.

Dated January 9, 1916.—Robert C. Leonard, M.D.; Bernard C. Tennent, M.D.

Dated January 10, 1916.—William E. David, M.B.; Walter T. James, M.B.

Dated January 11, 1916.—David Heron, F.R.C.S.Edin; Samuel Fleming, M.B.; Arthur P. Woollright.

Dated January 12, 1916.—Humphrey R. Pollock; Bernard E. Wall, M.B.; Finbar J. Hunt, M.B.; Albert Jones, M.D.; Robertson Y. Stones, M.B., F.R.C.S.Edin.; George O. Maw; Robert F. Jones; Donald G. M. Munro, M.D.; Gerald Scholfield, M.D., late Captain, The Hampshire Regiment (Volunteers).

Dated January 14, 1916.—Arthur Hines, M.B.

Dated January 15, 1916.—Norman K. Wilson, M.B.

The undermentioned to be temporary Lieutenants:—

Dated October 3, 1915.—Donald Mackay, M.B.

Dated November 3, 1915.—James Henry Cooke, M.B.

Dated December 13, 1915.—John Gibson Craig, M.B., F.R.C.S.Edin.; Reginald Simpson Harvey, M.B.; Cecil Frank Rumsey; Henry John Nightingale, M.B.,

F.R.C.S.; Harry Graham Smith; Laurence Fraser; Samuel Edward Thornhill Shann, M.B.; Walter Duffy, M.B.; Thomas Hill Twigg, M.B.; Llewellyn Drysdale Innes Graham, M.B.; Thomas Alfred Mayo, M.B., F.R.C.S.; John Eric Cheeseman; Thomas Lord Price; David Maxwell Clements, M.B.; Herbert Maxwell Vickers, M.B.; John Cameron, M.B.

Dated December 14, 1915.—Douglas Macleod Moffatt, M.D.; Norman Navarra; Harold Goodman.

Dated December 15, 1915.—Herbert Harrison; William Joseph Ashby, M.D.; William Herbert Blakemore; William Hamilton, M.D.; Fred Miller Murray; George Thomson; William Spence Melville, M.B.; Harry French Johns, M.D.

Dated December 16, 1915.—Leon Levene, M.B.; Henry William Martyn Strover, M.B.; Percy Stocks, M.B.; Percy Edward Brandon Barrow, M.B.; Patrick Allan Bennet Clark, M.B.; Morley Chadwick; Davis Woodcock Daniels, M.D., F.R.C.S.; John Shaw Dunn, M.D.; William Edward Jones; Bernard John Taylor Bennette; Wallace Edwin Hurford.

Dated December 17, 1915.—Vyvian Colmer; Cecil Roy Joyce, M.D.

Dated December 18, 1915.—Robert Alexander Johnston; John McIntyre, M.B.; William Jamieson Logie, M.B.; Henry Arthur Giles Hadden; Donald Gregor MacArthur, M.D.; Donald Kerr MacDougall, M.B.

Dated December 19, 1915.—William George Macdonald, M.B.

Dated December 20, 1915.—Richard Seaver Dollard; Harold Ernest Bloxsome; Samuel Algernon D'Arcy; Francis Hannigan; Percy Athelstan Nightingale, M.D; Harold Francis Brice-Smith; Harold Coppock, M.D.; Oliver Carlyle, F.R.C.S.Edin.; Arthur Chance, M.D., F.R.C.S.; John Joseph O'Kelly; William Charles Mence; Percy Nicol Allman.

Dated December 21, 1915.—Harry Hope Fisk; Gordon Winstanley Spencer, M.B.

Dated December 22, 1915.—George Cuthbert Adeney, M.B., F.R.C.S.; Charles Samuel Vartan, M.B.; Alec Terris Gibb, M.B.; John Kenyon Davies; William Wilson, M.D.; Francis Michael Byrne; John Smith, M.B.

Dated December 23, 1915.—Geoffrey Thomas Baker; Joseph Bogue Mackay, M.B.

Dated December 27, 1915.—Evan Parry Evans, M.D.

Dated December 28, 1915.—Joseph Chamney Atkinson Ridgway, M.D.; Helton Godwin Baynes, M.B.; Henry Currie Watson, M.D.; Frederick George Thomson, M.D.; Henry Stewart, M.B.; John Patrick O'Connor, M.B.; James Dewar Robertson, M.B.; Henry Catling; Selwyn Langstaff Haslett, M.B.

Dated December 29, 1915.—Hubert Sewell Sims, M.B.; Reginald Mark Moore, M.B.

Dated December 31, 1915.—Horace Simeon Berry; Geoffrey Collins.

Dated January 1, 1916.—John Beatson Dunning, M.B.; Joseph Alexander Thomson, M.B.; Francis Baldwin Pinniger, M.D.; James Rynd Briscoe, M.B.; Anson Robertson Jordan, M.B., F.R.C.S.; Richard Locke Bell; George Bertram Spencer Soper; James Dunbar, M.B.; George Sutherland, M.B.; Frederick Lionel Spalding; Victor Stanley Partridge; Paul de Cressé Potter; Harry Bond; Walter Richard Hugh Smith, M.D.; Robert Daniels Bell, M.B.; James William Hugh Boyd, M.B.; Henry Spiers, M.D., F.R.C.S.Edin.; Archibald Lumsdaine Pentland-Smith, M.B.; William Alexander Cochrane, M.B.; Harold Arthur Robert Edmond Unwin, M.B., F.R.C.S.; William Henry Gray; David Marcus Hanson; William Gibson Parker, M.B.; Herbert Child; Robert Hubert William Garle; John Rowland Payne; Samuel McComb, M.B.; John Stafford Johnson, M.B.; Harry Farncombe, M.B; Alexander Stewart, M.B.; Percy Booth Harrison; David Manson, M.B.; James Massey, M.B.; John Baird Cunningham, M.B.; Arthur Randell Jackson, M.D.; Michael Joseph Harkin, M.B.; Alexander Mennie Mitchell, M.B.; John Edward Joseph Roche Kelly; Arthur Murray Masters, M.D.; John Ernest Ruck; Robert John Mayberry, M.B.; Bertie Cecil Eskell, M.B.; Austin Clarence Dixon; Francis George Heard; James Dennis Mercer; David Lindley Sewell, M.B.; Howard Barclay Billups, M.B.; John Howard Addinsell; John Beaufoy Randall, M.B.; Wathen Ernest Waller, M.B.; Edgar Douglas Adrian, M.B.; William Aubrey Layard Marriott, M.B.; Bernard Francis Bailey; Charles Edward Iles, M.B.; Percy Ward Brigstocke, M.B.; John Bradbury Alexander, M.B.; David Alexander Thomson, M.B.; Thomas Weir McCubbin; Harold Edward Battle; John Munro Gage; Alan William Stuart Sichel, M.B.; Joseph Herbert Patrick Boyd Barrett, M.D.; Arthur Brebner; Francis Brett Young, M.B.; Jacobus Philip Ziervogel F.R.C.S.I.; Edward Dance Fountain; Arthur Alvin Martin, M.D.; James Phillips Jones; John Richard Griffith; Henry Quintin Osburne Wheeler; Arthur Edward Atkinson; Henry Tonks, F.R.C.S.

Dated January 2, 1916.—Bernard Charles William Pasco; Cecil Ernest Jones-Phillipson, M.D., F.R.C.S.Edin.,; Bernard Lethaby Morgan.

Dated January 3, 1916.—Claude Christian Hargreaves, M.B.; Frederick John Chanter Blackmore; John Bryan; James Joseph Healy, M.B.; John Magnus Redding, F.R.C.S.; William Stocks Lacey; Mackenzie Douglas, M.D.; John Watt; Alexander James Anderson, M.B.; Thomas Tierney, M.D.; Gilbert Alfred Back.

Dated January 4, 1916.—Oscar Le Feure Milburn; Burden Cox, M.D.; James Charles Buckley, M.D.; John Sadler Curgenven; Maurice Nicoll, M.B.; James Russell Magee; John Kirkwood Anderson.

Dated January 5, 1916.—Robert Rowlands; Solomon Harold Richards, M.B.; William Vernon Pegler; Tom Bates, M.B., F.R.C.S.; William Faulkner Valentine Simpson, M.B.; Anthony Feiling, M.D.; Charles Ernest Lewis Burman, M.B.

January 6, 1916.—Edward Evans; John Frederick Gallaher, M.B.

January 7, 1916.—Harold Ward Evans; Andrew Colville Wilson, M.D.; Harold George Rannie Jamieson, M.B.; William Hughes, M.B.; Robert Leighton Blenkhorn; M.B.; Harold Winnock Parrot, M.B.; Henry Charles Theodore Langdon, M.B.; Walter Douglas Kennedy, M.B.; Ramsden Walker Luis Fernandes, M.B.; Alan Samuel Lack Malcolm; Raymond Alfred Robert Green, M.B.

Dated January 8, 1916.—Philip Alfred Reckless, F.R.C.S.; Cecil Guedalla Sherowitz, M.B.; George James Jones, M.B.; Arthur Hendry, M.D.; Simon John Coulter Fraser, M.D.

Dated January 10, 1916.—John Morris Stewart; Thomas Winning, M.B.; Carl Euclid Molino; Digby Burns; Israel Feldman; Ernest Ravensworth Hart; Stanley Andrew Woollaston Munro, M.B.; Frederick Denys Crew, M.B.; David Henry Hall, M.B.; James Joseph O'Neill, M.B.; Guy Filby Palmer, M.D.; Leonard William Oliver; William Stevenson, M.B.; David Lees, M.B.; George Plunkett White, M.B.; Arthur Leonard Singer, M.B.; Israel Jacob Balkin, M.B.; Robert Morison Rowe, M.D., F.R.C.S.; William Brownlie, M.B.; Reginald Johnson, M.D.; James Albert Robinson.

Dated January 11, 1916.—Thomas Dowzer, F.R.C.S.I.; Ernest George Pringle, M.D.; James Potter.

The undermentioned temporary honorary Lieutenants to be temporary Lieutenants:—

Dated December 17, 1915.—Geoffrey Challen Linder.

Dated December 21, 1915.—Gordon Stuart Terry; David Hamilton Derry.

The undermentioned to be temporary honorary Lieutenants.

Dated November 19, 1915.—George Stanley Graham, M.B.

Dated November 29, 1915.—Oswald Gayer Morgan.

Dated December 22, 1915.—Arthur Tudor Edwards, F.R.C.S.

Dated December 23, 1915.—Ernest Ivon Davies.

Dated January 5, 1916.—William Ronald White-Cooper; John Gordon Ackland; John Edward Carbery Maguire.

Dated January 10, 1916.—Stanley Walter Isaacs.

Temporary Captain Charles N. Binney, M.B., relinquishes his commission, dated December 10, 1915.

Temporary Major Arthur L. Smith, M.D., relinquishes his commission, dated December 12, 1915.

Temporary Lieutenant-Colonel Leonard S. Dudgeon relinquishes his commission, dated December 27, 1915.

Temporary Honorary Lieutenant Angelo M. Crabtree, F.R.C.S., relinquishes his commission on ceasing to serve with the New Zealand War Contingent Hospital, dated January 3, 1916.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated August 5, 1915.—James B. Anderson, M.B.; Thomas E. A. Carr, M.B.; James G. B. Coleman, M.D.; Edgar Ashby; John F. Gill, M.B.

Dated August 25, 1915.—David Morrow.

Dated September 13, 1915.—Richard Bright.

Dated October 1, 1915.—Michael J. Hackett, M.B.

Dated October 19, 1915.—James H. Connolly, M.D., F.R.C.S.

Dated October 20, 1915.—Harry F. MacKendrick, M.D.

Dated October 24, 1915.—John W. O'Farrell.

Dated November 1, 1915.—James W. Richardson, F.R.C.S.Edin.

Dated November 2, 1915.—Francis K. Kerr, M.B.

Dated November 10, 1915.—Denis G. Halsted, M.B.

Dated November 17, 1915.—Maurice C. Turiansky, M.B.

Dated December 1, 1915.—Charles W. Hamilton, M.D.; Joseph E. Barnes, M.B.; Ricardo Cope; Arthur N. Leeming, M.B.; Joseph G. Macqueen, M.B.; Andrew T. Ross, M.D., F.R.C.S.Edin.; John F. Gibbons; William J. F. Mayne, M.B.; Mackenzie Douglas, M.D.; John C. L. Day.

Dated December 4, 1915.—Reginald W. Clark; John G. McDougall, M.B.; William G. Helsby; James Potter.

Dated December 7, 1915.—Charles C. Holman, M.B., F.R.C.S.; Vynne Borland, M.B.; John C. McConaghey, M.D.; Roderick A. Campbell, M.D.; Hans Fleming, M.B.

Dated December 10, 1915.—Wilfred H. W. Atlee, M.D.; Allan R. Wilson, M.D.

Dated December 14, 1915.—John Anderson, M.B.; Richard T. Worthington, M.B.; Walter J. Harper.

Dated December 15, 1915.—William F. Dunlop, M.B.; Horace E. H. Tracy; George B. Horrocks; George J. B. Candler-Hope, M.B.

Dated December 16, 1915.—William Readman, M.B.; Charles T. Bishop, M.B.; Ernest G. Wheat, M.D.; John Duffin, M.B.; Edward H. A. Pask, M.D.; Douglas Elder, M.B.

Dated December 17, 1915.—Bertram M. Bone, M.B., F.R.C.S.Edin.

Dated December 18, 1915.—William McH. Binning; George R. Phillips.

Dated December 28, 1915.—Michael Sullivan; John H. Douglas, M.D.; Sylvester D. Fairweather, M.B.; Herbert D. Robertson, M.B.; Peter Reid, M.B.

Dated December 30, 1915.—Richard E. Sedgwick, M.D.; William Taylor, M.B.

Dated January 2, 1916.—Patrick J. Maguire; John D. Cherry.

Dated January 6, 1916.—Charles E. Pepper, M.B.

Dated January 7, 1916.—John L. Annan, M.B.; Wilfred Garton; Herbert E. Clarke; Robert W. Greatorex, M.B.; John R. Askew, F.R.C.S.

Dated January 10, 1916.—Robert K. Nisbett.

Dated January 12, 1916.—Ignatius P. Kelly.

Dated January 16, 1916.—Randal MacCarthy.

Dated January 26, 1916.—Arthur N. Houghton, M.B.

Dated January 28, 1916.—David J. McAdam, M.B.

Dated January 29, 1916.—Claude R. Lucas.

Dated January 30, 1916.—David J. Miller, M.D.

The undermentioned Lieutenants in the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated December 4, 1915.—Vincent Keating O'Gorman; George Cooper, M.B.; Reginald Charles Jeremie Stevens, M.B.; Ernest Fielden Nivin.

Dated December 18, 1915.—Harold Ernest Brown, M.B.; Farrent Lismere Hill, M.D.; William Arthur Rupert Michell, M.B.; James Henry Egbert; Theodore George Harwood Drake, M.B.; Maurice Aloysius Kenny, M.D.

Dated December 23, 1915.—Charles Alfred Dupont, M.D.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated December 21, 1915.—John Reid.

Dated December 22, 1915.—William Cooper.

Dated December 27, 1915.—George Frederick Drayson.

Dated December 28, 1915.—Roland Arthur Arkell; Richard Bolster Holland.

Dated January 1, 1916.—Harold Pulham; George Taylor.

Dated January 5, 1916.—George Stainton; Lawrence Lazarus Franks.

Dated January 6, 1916.—Alfred Clarke Little.

Dated January 7, 1916.—John Henry Willden.

Dated January 16, 1916.—Ernest Brodie Snowden.

Dated January 17, 1916.—Robert George Edmund Whitney.

The date on which temporary Quartermaster and Honorary Lieutenant Thomas Brina relinquished his commission is December 11, 1915, and not as stated in the *Gazette* of December 6, 1915.

TERRITORIALS.

Royal Army Medical Corps.

1*st London* (*City of London*) *Sanitary Company*.—The undermentioned Lieutenants to be Captains: James E. Wilson, M.D., dated November 10, 1915; Cuthbert E. C. Ferrey, dated November 22, 1915; Walter D. Carruthers, M.B., dated December 1, 1915; Archibald Romanes, M.B., dated December 7, 1915; Colin C. Frye, dated December 7, 1915; Harry G. A. Pearson, dated December 8, 1915; Captain Colin C.

Frye is seconded for duty under the Ministry of Munitions, dated December 13, 1915; Captain Charles J. D. Gair is restored to the establishment, dated January 1, 1916; The undermentioned to be Lieutenants: Wilfred Samuel Hamilton Campbell, M.B., dated December 10, 1915; William Alexander Francis Balfour Browne, dated December 15, 1915; Alfred Reid, dated December 17, 1915; John Tate, dated January 8; 1916; Corporal Norman Shirley Golding, from 36th Battalion, Canadian Expeditionary Force, dated January 10, 1916.

1st London (City of London) Field Ambulance.—Captain Archibald Leitch, M.B., is seconded, dated June 24, 1915; Captain Archibald Leitch, M.B., is restored to the establishment, dated December 24, 1915; Lieutenant Thomas A. Townsend to be Captain, dated December 25, 1915.

2nd London (City of London) Field Ambulance.—Major (temporary Leiutenant-Colonel) William V. Sinclair relinquishes the temporary rank of Lieutenant-Colonel on alteration in posting, dated July 5, 1915; Major Edwin C. Montgomery-Smith to be temporary Lieutenant-Colonel, dated January 20, 1916.

2nd London Sanitary Company.—The undermentioned Lieutenants (temporary Captains) to be Captains, dated April 1, 1915: Frederick G. Caley; William J. M. Slowan, M.D.; Lieutenant George S. Hoffman to be Captain, dated December 17, 1915; Captain Herbert Beeney is placed temporarily on the Retired Pay List on account of ill-health dated January 14, 1916; Charles Herbert Lilley, M.B., to be Lieutenant, dated January 14, 1916; Harold Vickers to be Lieutenant, dated January 20, 1916.

2nd London Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: Allan C. Pearson, M.B., dated December 16, 1915; John C. W. Methven, dated December 16, 1915. Hamilton Drummond, M.B. (late Lieutenant, Northumberland (Hussars) Yeomanry), to be Lieutenant, dated January 9, 1916; Frederick Adolph Dick, M.B., to be Lieutenant, dated January 20, 1916.

3rd London General Hospital.—The undermentioned to be Lieutenants: Douglas Noel Hardcastle, dated August 15, 1915; Albert William Bowie, M.B., dated August 15, 1915; Louis Abel Célestin, dated August 19, 1915; Walter Leopold Holyoak, M.B., dated August 21, 1915; Arthur Kingsford, dated August 18, 1915.

3rd London (City of London) Field Ambulance.—Joseph Howell Lloyd, M.B., to be Lieutenant, dated January 13, 1916.

6th London Field Ambulance.—Major Henry K. Dawson, M.D., to be temporary Lieutenant-Colonel, dated November 30, 1915; Lieutenant Richard T. Caesar to be Captain, dated December 31, 1915.

1st Scottish General Hospital.—Lieutenant Patrick T. Catto, M.B., to be Captain, dated December 15, 1915.

Scottish Horse Mounted Brigade Field Ambulance.—Lieutenant Francis M. Halley to be Captain, dated January 10, 1916.

Highland Mounted Brigade Field Ambulance.—Lieutonant (temporary Captain) Alexander F. Lee, M.D., to be Captain, dated April 1, 1915; Lieutenant John Frederick Neary, M.B., to be Captain, dated December 23, 1915.

1st Highland Field Ambulance.—Bernard Langridge Davis to be Lieutenant, dated January 4, 1916.

3rd Highland Field Ambulance.—Andrew John McIvor, M.B., to be Lieutenant, dated January 29, 1916.

Highland Divisional Sanitary Section.—Alexander Fraser MacBean, M.B., to be Lieutenant, dated October 22, 1915.

Highland Casualty Clearing Station.—The appointment of Alexander Fraser MacBean, M.B., as Lieutenant, which was announced in the *London Gazette* of the November 9, 1915, is cancelled.

Lowland Mounted Brigade Field Ambulance.—Captain (temporary Major) Farquhar Gracie, M.B., to be Major, dated October 22, 1915.

1st Lowland Field Ambulance.—Serjeant-Major David Law Clark, from 2nd Lowland Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, and seconded for duty with 1st Provisional Brigade Field Ambulance, dated January 10, 1916.

Lowland Casualty Clearing Station.—Serjeant-Major Andrew Hunter Mackie, from 3rd Scottish General Hospital, to be Quartermaster with the honorary rank of Lieutenant, dated January 1, 1916.

1st Northumbrian Field Ambulance.—Lieutenant Andrew Govan McFarlane, M.B., to be Captain, dated December 25, 1915; Francis J. B. Robson, M.B., dated January 7, 1916; Charles G. Strachan, M.B., dated January 8, 1916.

2nd Northumbrian Field Ambulance.—Lieutenant Christopher Rogers, M.B., to be Captain, dated November 17, 1915.

Northumbrian Casualty Clearing Station.—Captain Frederick John Nattrass, M.B., from 1st Northern General Hospital, to be Captain, dated January 13, 1916.

1st West Riding Field Ambulance.—Lieutenant Charles S. Brown, M.B., to be Captain, dated December 16, 1915; Lieutenant Thomas Ingham Mills to be Captain, dated December 27, 1915.

2nd West Riding Field Ambulance.—The undermentioned Lieutenants to be Captains: Alfred George Hebblethwaite, dated November 6, 1915; Alexander Anderson, dated November 20, 1915.

3rd West Riding Field Ambulance.—Lieutenant William Sneddon, M.B., to be Captain, dated November 21, 1915.

1st East Lancashire Field Ambulance.—Cecil Hibbert, M.D., to be Lieutenant, dated January 4, 1916; Francis William Schofield, M.B., to be Lieutenant, dated January 4, 1916; John Young, M.B., to be Lieutenant, dated January 10, 1916.

2nd East Lancashire Field Ambulance.—Lieutenant Arthur W. Havard, M.B., to be Captain, dated December 30, 1915; Lieutenant Ernest L. Forward, to be Captain, dated December 30, 1915; Ernest Hulme, M.B., to be Lieutenant, dated January 4, 1916.

3rd East Lancashire Field Ambulance.—John Radcliffe Jagger, M.B., to be Lieutenant, dated January 26, 1916.

1st West Lancashire Field Ambulance.—Captain James Wood, to be temporary Major, dated January 13, 1916; Quartermaster-Serjeant William Cowen Griffiths to be Quartermaster, with the honorary rank of Lieutenant, dated January 23, 1916.

2nd West Lancashire Field Ambulance.—Transport Officer and Honorary Lieutenant George Kilburne resigns his commission, dated January 20, 1916.

3rd West Lancashire Field Ambulance.—Norman Stuart Jeffrey, M.B. (late Captain, 5th Battalion, The King's Own (Royal Lancaster Regiment)), to be Captain, dated January 1, 1916.

West Lancashire Divisional Sanitary Section.—Lieutenant William H. Hill, from 2nd London Sanitary Company, to be Lieutenant, dated December 23, 1915.

West Lancashire Casualty Clearing Station.—The date of appointment of Lieutenant Theodore H. Somervell is May 17, 1915, and not as stated in the *London Gazette* of June 19, 1915; Lieutenant Theodore H. Somervell to be Captain, dated November 17, 1915; Lieutenant Thomas Aspinall, from Attached to Units other than Medical Units, to be Lieutenant, dated January 12, 1916.

1st South Midland Field Ambulance.—Captain Frederic E. France, M.B., relinquishes his commission on account of ill-health, dated January 7, 1916.

North Midland Mounted Brigade Field Ambulance.—Lieutenant Herbert W. Grieg to be Captain, dated December 21, 1915.

North Midland Casualty Clearing Station.—John Webster Archibald, M.B., to be Lieutenant, dated December 14, 1915; Claude Stewart James Kearney to be Lieutenant, dated December 22, 1915.

1st North Midland Field Ambulance.—James Davison Allen, M.B. (late Captain in this Unit), to be Captain, dated December 3, 1915.

Notts and Derby Mounted Brigade Field Ambulance.—Lieutenant Guy Witton Miller to be Captain, dated November 24, 1915.

1st Northern General Hospital.—Captain Colin Mearns, M.B., from Northumbrian Casualty Clearing Station, to be Captain, dated December 27, 1915; Lieutenant William Johnston, M.B., to be Captain, dated January 8, 1916.

2nd Northern General Hospital.—Major Albert S. F. Leyton, M.D., is seconded, dated September 4, 1915.

3rd Northern General Hospital.—Captain Graham S. Simpson, F.R.C.S., is seconded whilst holding a temporary commission as Major in the Royal Army Medical Corps, dated May 19, 1915. The undermentioned are seconded, dated September 4, 1915: Major Arthur J. Hall, M.D.; Major Albert E. Naish, M.B.; Captain William H. Nutt, M.D.; Captain Frank A. Hepworth, F.R.C.S. The undermentioned Lieu-

tenants to be Captains, dated November 8, 1915: Balfour McKean, M.D.; Robert P. Anderson, M.B.; John Stokes, M.D., dated December 9, 1915; William W. N. King, M.B., F.R.C.S.Edin., dated December 25, 1915; Theodore Allen, M.B., dated December 25, 1915; Lieutenant Gordon Fowler Stones, M.B., to be Captain, dated January 1, 1916.

4th Northern General Hospital.—Captain Henry J. Smith, M.B., is seconded for duty with 2nd East Anglian Field Ambulance, dated December 20, 1915; Captain Basil H. C. Lea-Wilson is seconded for duty with 2nd East Anglian Field Ambulance, dated December 20, 1915.

South Wales Mounted Brigade Field Ambulance.—Lieutenant (temporary Captain) Josiah Browne to be Captain, dated April 1, 1915; Lieutenant Alfred W. W. Hayles to be Captain, dated December 9, 1915.

Welsh Border Mounted Brigade Field Ambulance.—Lieutenant (temporary Captain) Robert Francis Gerrard to be Captain, dated April 1, 1915.

2nd Welsh Field Ambulance.—Evan Williams Griffith (late temporary Lieutenant, Royal Army Medical Corps) to be Captain, dated December 16, 1915; Joseph Stephen Wallace to be Lieutenant, dated December 25, 1915.

1st Eastern General Hospital.—Serjeant-Major Harry McIntyre to be Quartermaster, with the honorary rank of Lieutenant, dated January 19, 1916.

South Eastern Mounted Brigade Field Ambulance.—Lieutenant William Tresawna, M.B., to be Captain, dated November 12, 1915; Transport Officer and Honorary Major Lewis H. Coles resigns his commission, dated January 5, 1916.

2nd South Western Mounted Brigade Field Ambulance.—Lieutenant Wilfred S. Soden to be Captain, dated December 20, 1915.

3rd Western General Hospital.—Lieutenant Thomas R. Bowen to be Captain, dated November 3, 1915; Lieutenant Gilbert I. Strachan, M.D., to be Captain, dated December 13, 1915.

1st Wessex Field Ambulance.—Major Alexander W. F. Sayers to be temporary Lieutenant-Colonel, dated January 10, 1916.

2nd Wessex Field Ambulance.—Transport Officer and Honorary Lieutenant Frederick J. Miller resigns his commission, dated December 13, 1915.

3rd Wessex Field Ambulance.—Captain Arthur C. Hinks, from 2nd Wessex Field Ambulance to be Captain, dated April 1, 1915.

Wessex Casualty Clearing Station.—Captain Arthur E. Huxtable, from 3rd London Field Ambulance, to be Captain, dated January 9, 1916; Captain Alfred Coleridge, M.B., from Attached to Units other than Medical Units, to be Captain, dated January 14, 1916.

1st Home Counties Field Ambulance.—Lieutenant George Hislop, M.B., to be Captain, dated December 7, 1915.

2nd Home Counties Field Ambulance.—Transport Officer and Honorary Lieutenant Frank Buss resigns his commission, dated November 2, 1915.

3rd Home Counties Field Ambulance.—John James Cecil Hamilton to be Lieutenant, dated August 1, 1915.

Home Counties Casualty Clearing Station.—Serjeant Charles Austen Gilbert, from 1st Home Counties Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated January 8, 1916.

1st East Anglian Field Ambulance.—The appointment of Quartermaster and Honorary Lieutenant Harry G. Aldiss, which appeared in the *London Gazette* of December 14, 1915, is antedated, November 4, 1915.

2nd East Anglian Field Ambulance.—Major William J. Caie, M.B., relinquishes his commission on account of ill-health, dated January 14, 1916.

3rd East Anglian Field Ambulance.—Ralph Jack Richard Mecredy to be Lieutenant, and seconded for duty with 5th Provisional Field Ambulance, dated November 15, 1915.

East Anglian Casualty Clearing Station.—Lieutenant Joseph Green, M.D., to be Captain, dated October 20, 1915.

1st Southern General Hospital.—Lieutenant Herbert C. H. Bracey, M.B., to be Captain, dated November 6, 1915; Lieutenant Arthur P. Thomson, to be Captain, dated January 12, 1916.

4th Southern General Hospital.—The following announcement is substituted for that which appeared in the *London Gazette* of December 20, 1912; Captain John Wallis Gill, to be Major, dated January 29, 1912.

5th Southern General Hospital.—Captain John Blackwood is seconded for duty with 1st East Anglian Field Ambulance, dated December 20, 1915.

TERRITORIALS.

Royal Army Medical Corps.

Captain Robert Magill, M.B., to be temporary Major whilst in command of a Field Ambulance, dated November 5, 1915.

Lieutenant (on probation) Thomas R. Davies is confirmed in his rank.

The undermentioned Lieutenants to be Captains:—

Eric Jamieson, M.B., dated December 2, 1915.

William McE. Snodgrass, dated December 18, 1915.

John G. Henry, dated December 21, 1915.

Lieutenant Andrew C. Cassells, M.B., is placed temporarily on retired pay on account of ill-health, dated January 2, 1916. (Substituted for the notification which appeared in the *Gazette* of January 1, 1916.)

Supernumerary for Service with the Officers Training Corps.

Lieutenant Wynfrid L. H. Duckworth, M.D., to be temporary Captain whilst serving with the Medical Unit of the Cambridge University Contingent, Senior Division, Officers Training Corps, dated November 20, 1915.

The undermentioned Lieutenants to be temporary Captains whilst serving with the Medical Unit of the University of London Contingent, Senior Division, Officers Training Corps, dated November 20, 1915; William Gilliatt; Richard D. Maxwell, M.B.

Arthur Wyndowe Willert Baker, M.D., F.R.C.S.I., to be Lieutenant for service with the Medical Unit of the Dublin University Contingent, Senior Division, Officers Training Corps, dated January 19, 1916.

Attached to Units other than Medical Units.

Lieutenant-Colonel Charles Graham Grant, from the Territorial Force Reserve, to be Lieutenant-Colonel, dated February 28, 1915.

Lieutenant Thomas P. Caverhill, M.B., to be Captain, dated May 2, 1915.

Lieutenant William N. P. Williams to be Captain, dated July 13, 1915.

Lieutenant Thomas W. Cole, M.B., to be Captain, dated August 28, 1915.

William Henry Buckley to be Lieutenant, dated October 15, 1915.

Lieutenant William L. Griffiths, M.D., F.R.C.S., to be Captain, dated October 23, 1915.

Lieutenant John McGregor to be Captain, dated November 11, 1915.

The following announcement is substituted for that which appeared in the *London Gazette* of November 13, 1915.

Captain William L. Griffiths, M.D., F.R.C.S., resigns his commission on account of ill-health, dated November 14, 1915.

Captain Alexander F. Lee, M.D., from the Highland Mounted Brigade Field Ambulance, to be Captain, dated November 21, 1915.

Lieutenant Norman P. Laing, M.B., to be Captain, dated December 1, 1915.

Lieutenant Robert B. Reed, M.B., to be Captain, dated December 7, 1915.

Captain Herbert E. Murray, M.B., relinquishes his commission on appointment to the Indian Medical Service, dated December 8, 1915.

Lieutenant John Wood to be Captain, dated December 16, 1915.

Lieutenant Alexander Silbermann to be Captain, dated December 23, 1915.

Alexander Stewart, M.B., to be Lieutenant, dated January 3, 1916.

Surgeon-Major Robert B. Purves, from the Lincolnshire Yeomanry, to be Major, dated January 13, 1916.

John Livingston Hamilton to be Lieutenant, dated January 13, 1916.

Frederick Joshua Page Saunders to be Lieutenant, dated January 14, 1916.

John Armstrong Hartley, M.D., to be Lieutenant, dated January 26, 1916.

The announcement of the resignation of Captain William L. Griffiths, M.D., which appeared in the *London Gazette* of January 8, 1916, is cancelled.

Major Alfred Robinson, M.D., relinquishes his commission on account of ill-health, dated January 20, 1916.

Captain George B. Forge relinquishes his commission on account of ill-health, dated January 20, 1916.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE ON WEDNESDAY, JANUARY 19, 1916.

Present.

Surgeon-General M. W. Russell, C.B., in the Chair.
Lieutenant-Colonel E. M. Pilcher, D.S.O.
Lieutenant-Colonel W. Blackwell.

Letters of apology for absence were read from Surgeon-General Sir David Bruce, Surgeon-General W. Donovan, and Captain F. Crookes.

(1) The Minutes of the last meeting were read and confirmed.

(2) Sanction was given for a grant from the General Relief Fund of £4 to Mr. M. K. Q. during the past quarter.

(3) It was noted that the following grants were received from Royal Army Medical Corps units during the quarter ending December 31, 1915, for the General Relief Fund :—

Royal Army Medical Corps, Tidworth..	£25	0	0
,, ,, ,, Colchester	2	0	0
,, ,, ,, Millbank Serjeants' Mess ..	4	0	0
	£31	0	0

(4) The total grants received from units for the past year to the General Relief Fund were noted and are attached hereto. It was resolved that a letter should be sent to all units serving at home and abroad, asking for subscriptions. Lieutenant-Colonel Blackwell kindly consented to give the Secretary a list of places where the Royal Army Medical Corps units are now serving.

(5) A letter asking for a donation was read from the Secretary of the Army and Navy Male Nurses' Co-operation. It was resolved to give a donation of £5 for this year.

(6) With reference to Minute 13 of the last meeting, it was noted that thirteen re-employed retired officers have consented to subscribe to the Fund.

(7) It was noted that Surgeon-General F. J. Jencken consented to act as Auditor,

(8) The accounts for 1915 were considered and approved subject to a certificate from an Auditor that he had inspected the shares certificates in the hands of the bankers.

(9) As the Band President had failed to send the Band Acconnts for the past quarter, they could not be placed before the Committee for approval.

(10) It was decided that Lieutenant-Colonel E. M. Wilson be elected to represent retired officers on the Committee, subject to his consent to act.

(11) A sum of £2 10s. was voted for office furniture.

124, Victoria Street, S.W.,
January 20, 1916.

F. W. H. DAVIE-HARRIS,
Lieutenant-Colonel,
Secretary.

ROYAL ARMY MEDICAL CORPS GENERAL RELIEF FUND.

Grants received from Royal Army Medical Corps Units during 1915.

Aldershot	£200	0	0	Ceylon	*Nil*		
Netley	10	0	0	Hong Kong	,,		
Cosham	5	0	0	Gibraltar, £4 ; Serjeants' Mess, £3	£7	0	0
Devonport	10	0	0	Jamaica	*Nil*		
York	*Nil*			Malta	8	5	0
Colchester	52	0	0	Mauritius	*Nil*		
Chatham	10	0	0	Singapore	,,		
Shorncliffe	4	0	0	Cairo. Serjeants' Mess	5	0	0
Dover	9	5	7	London, Serjeants' Mess, Millbank	4	0	0
Woolwich	17	10	0	No. 43 Field Ambulance	1	14	9
Edinburgh	*Nil*			Training Centre, Sling	10	0	0
Dublin	,,			,, ,, Limerick	5	5	0
Belfast	10	0	0	,, ,, Llandindod Wells	10	0	0
Cork	3	0	0	Bulford, Serjeants' Mess	5	0	0
Curragh	*Nil*						
London (Rochester Row)	1	0	0				
Chester	*Nil*						
Tidworth	25	0	0				
Bermuda	*Nil*				£413	0	4

ROYAL ARMY MEDICAL CORPS FUND FOR THE YEAR 1915.

Receipts.		£	s.	d.
Balance in hand, December 31, 1914—				
Current Account	£196 13 0			
Deposit Account	200 0 0			
		396	13	0
Subscriptions		1,098	19	6
Refund Postage R.A.M.C. Comforts		2	0	0
Interest on Deposit Accounts		7	14	7
Dividends :—				
War Loan, 1915		15	6	0
Caledonian Railway..		50	15	10
North British Railway		52	11	3
		£1,624	**0**	**2**

Expenditure.	£	s.	d.
Grant to Band	138	0	0
,, General Relief Fund	80	0	0
Fire Insurance Q.A.M.H. Chapel	4	5	6
Royal School for Officers' Daughters	26	5	0
Purchase of £800 War Loan, 1915	795	14	5
Grant towards Publication of " A History of the Corps," by Colonel Johnston, C.B.	150	0	0
Banker's Charges	0	4	2
Shorthand writer	1	1	0
Secretary and Office	90	0	0
Stationery	1	18	11
Printing	0	10	6
Postage	2	11	1
Share of Type Machine	**9**	**15**	**9**
Balance in Hand, December 31, 1915	**323**	**13**	**10**
	£1,624	**0**	**2**

Investments.

Caledonian Railway 4 % Preference Stock	**£1,408**	**0**	**0**
N. British Railway 4½ % Preference Stock	**1,457**	**0**	**0**
War Loan, 1915, 4½ %	**800**	**0**	**0**
	£3,665	**0**	**0**

STATEMENT OF ACCOUNTS OF THE GENERAL RELIEF FUND FOR THE YEAR 1915.

Receipts.		£ s. d.
Balance in hand, December 31, 1914—		
Current Account	£410 10 9	
Deposit Account	400 0 0	
		810 10 9
Grant from Companies		413 0 4
,, ,, R.A.M.C. Fund		80 0 0
Rebate of Income Tax		5 10 5
Mrs. Kay, for child's schooling		6 15 0
Subscriptions and Donations		7 18 0
Interest on Deposit Account		5 10 0
Donation, Lady Saunders		30 0 0
Dividends—		
War Loan, 1915 (Less Tax)		11 9 6
Canada Stock (Less Tax)		18 15 7
East India Railway (Less Tax)		31 16 1
		£1,421 5 8

Expenditure.	£ s. d.
Grants to Companies	21 0 0
Union Jack Club Subscription	25 4 0
Soldiers' and Sailors' Help Association	5 0 0
Association for Employment of ex-Soldiers	5 0 0
Corps of Commissionaires	10 0 0
A. and N. Male Nurses Co-op.	5 0 0
R.A.M.C. Comforts	100 0 0
Purchase, £600 War Loan	596 15 10
Royal Soldiers' Daughters' Home (Girl Kay)	6 16 0
Bankers' Charges	0 0 9
Balance in hand, December 31, 1915	646 9 1
	£1,421 5 8

Investments.	£ s. d.
Canada 3½ % Reg. Stock	606 6 8
East India Railway 3½ % Deb. Stock	1,060 0 0
War Loan 4½ %, 1915	600 0 0
	£2,266 6 8

STATEMENT OF COMPASSIONATE SCHOOL FUND ACCOUNTS.

Receipts.		£ s. d.
Balance in hand, December 31, 1914—		
Current Account	£56 11 2	
Deposit Account	300 0 0	
		356 11 2
Interest on Deposit Account		5 2 7
		£361 13 9

Expenditure.		£ s. d.
Royal Soldiers' Daughters' Home		57 0 0
Drummond Institute		5 0 0
Home for Catholic Children		12 0 0
Balance in hand, December 31, 1915—		
Current Account	£87 13 9	
Deposit Account	200 0 0	
		287 13 9
		£361 13 9

ROYAL ARMY MEDICAL CORPS FUND BALANCE SHEET.

Statement of Accounts.

Assets.		£ s. d.
Balance per Pass Book, December 31, 1914	£681 4 11	
Receipts, 1915	3,381 11 11	
		4,062 16 10
Expenditure per Pass Book, 1915		2,967 0 2
Balance in Bank, December 31, 1915		1,095 16 8
Catholic School Fund Deposit Account		200 0 0
Investments, R.A.M.C. Fund—		
,, Caledonian Railway	£1,408 0 0	
,, North British Railway	1,457 0 0	
,, War Loan, 1915	800 0 0	
		3,665 0 0
Investments, General Relief Fund—		
,, Canadian Stock	£606 6 8	
,, East India Railway	1,060 0 0	
,, War Loan, 1915	600 0 0	
		2,266 6 8
		£7,227 3 4

Liabilities.	£ s. d.
To R.A.M.C. Fund	3,988 13 10
,, General Relief Fund	2,912 15 9
,, Compassionate School Fund	287 13 9
Outstanding Cheque	38 0 0
	£7,227 3 4

January 5, 1916.

Examined and found correct,

(*Signed*) F. J. JENCKEN, *Surg.-General.*

E. M. WILSON, *Lieut.-Colonel*, R.P.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE ON WEDNESDAY, JANUARY 19, 1916.

Present.

Surgeon-General M. W. Russell, C.B., Vice-President, in the Chair.
Lieutenant-Colonel A. B. Cottell.
Lieutenant-Colonel E. M. Pilcher, D.S.O.

(1) The minutes of the last meeting were read and confirmed.

(2) The accounts for 1915 were considered and passed, and are attached hereto.

(3) The Report of the Committee for the year 1915 was considered and adopted.

(4) It was noted that a donation of £25 had been received from the Medical Insurance Agency (making altogether £50 for the year) for which a letter of thanks has been sent. It was decided that this donation should also be earmarked for the orphans of officers who held temporary commissions in the R.A.M.C.

(5) The receipt of a donation of £10 10s. from the South-West London Medical Society was noted. It was decided that this donation should also be earmarked for the orphans of officers who held temporary commissions.

(6) The following donations were also noted as having been received :—

Mrs. Hayes	£10
Lieutenant-Colonel H. V. Prynne	6

(7) A sum of £2 10s. was sanctioned for office furniture.

F. W. H. DAVIE HARRIS,
Lieutenant-Colonel,
Secretary.

124, *Victoria Street, S.W.*
January 20, 1916.

REPORT OF THE COMMITTEE FOR THE YEAR 1915.

(1) The number of subscribers for the year was 168, and the amount of subscriptions was £176 10s. 6d.

(2) The donations amounted to £79 13s., of this amount £50 was received from the Medical Insurance Agency, and has been earmarked for the benefit of orphans of officers who held temporary commissions in the R.A.M.C.

(3) The total receipts amounted to £973 13s. 2d.

(4) The total expenditure amounted to £725 18s. 3d.

(5) Twenty-five applicants representing forty-one orphans were granted £630, varying in amounts up to £4.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

Statement of Accounts for the year 1915.

Receipts.		£ s. d.
To Balance in Bank, January 1, 1915		383 4 6
,, Subscriptions		176 10 6
,, Rebate of Income Tax		85 2 8
,, Donations—		
Medical Insurance Agency	£50 0 0	
S.W. London Medical Society	10 10 0	
Mrs. Hayes	10 0 0	
E. J. Hopwood, Esq.	3 3 0	
Lieutenant-Colonel H. V. Prynne	6 0 0	
		79 13 0
,, Refund Postage R.A.M.C. Comforts		2 0 0
,, Dividends—		
North Eastern Railway 3 % Debenture Stock (*less* tax £19 11s. 8d.)		180 7 10
London & North Western Railway 3 % Debenture Stock (*less* tax £19 15s. 10d.)		180 4 4
Midland Railway 2½ % Debenture Stock (*less* tax £15 13s. 4d.)		144 6 8
Caledonian Railway 4 % Debenture Stock (*less* tax £15 3s. 8d.)		96 0 4
Consols		29 7 10
		£1,356 17 8

Expenditure.	£ s. d.
By Grants	630 0 0
,, Auditors' Fees	1 1 0
,, Secretarial and Office Expenses	90 0 0
,, Stationery	1 19 0
,, Printing	0 10 6
,, Postage	2 11 0
,, Share of Typewriting Machine	9 15 9
,, Verification of Consols	0 1 0
,, Balance in Bank, December 31, 1915	620 19 5
	£1,356 17 8

Investments.	£ s. d.
London & North Western Railway 3% Debenture Stock	6,667 0 0
North Eastern Railway 3 % Debenture Stock	6,666 0 0
Midland Railway 2½ % Debenture Stock	6,400 0 0
Caledonian Railway 4 % Debenture Stock	2,780 0 0
Consols	1,327 7 9
	£23,840 7 9

We have compared the above statement with the books and papers relating thereto, and certify that it is correct. We have verified the Bank Balance and the Investment in Consols, and have inspected the Certificates of the Investments in Railway Stocks as set out.

Portland House,
Basinghall Street, E.C.
January 6, 1916.

(*Signed*) EVANS, PEIRSON & CO.,
Chartered Accountants.

LADY SLOGGETT'S ROYAL ARMY MEDICAL CORPS COMFORT FUND.

STATEMENT OF ACCOUNTS TO DECEMBER 31, 1915.

RECEIPTS.	£	s.	d.
Cash received by Lieutenant-Colonel Harris—			
From November 14, 1914, to June 30, 1915 ..	1,182	19	1
From July 1, 1915, to December 31, 1915	969	6	10
	£2,152	5	11

EXPENDITURE.		£	s.	d.
Advertisements		11	14	8
Telephone Company		7	10	0
Gamage, Ltd.		520	1	1
Army and Navy Stores		444	16	6
The Empire Service		508	15	10
Nestle's Milk Company		62	12	8
J. Lyons, Ltd.		42	3	4
Boots, Ltd.		86	5	0
Messrs. Derry and Toms		80	11	7
L. and S.W. Railway		20	18	8
Drayton Paper Works		2	5	11
Messrs. Brown and Son		1	5	0
Geo. Dray and Son		5	15	0
Postage £4; Printing, 12s.		4	12	0
Bankers' Charges		1	4	1
Incidental Expenses		1	0	0
R.A.M.C. Mess Refreshments		16	17	6
Mrs. Morgan: Imprest Account—				
Postage including Parcels	£8 12 0			
Carriage of Parcels	2 16 6			
Christmas Tips	2 2 6			
Packing Material, etc.	22 18 6			
Season Ticket	33 15 0			
Balance in hand	0 0 6			
		70	5	0
Balance in hand, December 31, 1915		263	12	1
		£2,152	5	11

Audited and found correct,
EDMOND T. GANN.

January 14, 1916.

ROYAL ARMY MEDICAL CORPS COMFORTS FUND.

SECRETARY'S REPORT OF THE WORK DONE.

At the beginning of October, 1914, a central committee of ladies was formed, composed of Mesdames Babtie, Whitehead, Macpherson, Woodhouse, Russell, Treherne and Lady Bruce, wives of Surgeon-Generals of the Army Medical Service, with Lady Sloggett, wife of the Director-General of the British Forces in France, as Chairman, and Mrs. C. K. Morgan, as Secretary and Manager.

The object of this Committee was the collecting, packing and forwarding of comforts to the various medical units in France.

During 1915 this work was further enlarged, and bales of comforts have been sent to Gallipoli, and latterly to Salonika.

Since the Spring of 1915, parcels have been forwarded weekly to Royal Army Medical Corps men who were prisoners of war in Germany, either directly by the Comforts Fund, or by ladies who so kindly "adopted" a man for a given period.

Altogether 2,040 bales have been sent out from the Royal Army Medical College, London, where packing rooms were very kindly placed at the disposal of the Committee. Of this number 607 bales, each weighing 11 lbs., have been sent to prisoners of war in Germany, and 1,433 bales averaging 50 lb. in weight have been forwarded overseas.

The following is a list of the principal articles despatched :—

Shirts	5,469	Biscuits and cakes ..	1,776 tins.
Socks	16,081 prs.	Milk	4,896 ,,
Pants and vests	6,576	Chocolate	2,378 lbs.
Cigarettes and cigarette papers	26,928 pkts.	Writing paper	26,928 pkts.
Tobacco	930 lbs.	Games	3,403
Preserved meats	2,652 tins.	Packs of cards	2,183
		Pipes	5,100

Also helmets, cardigans, scarves, handkerchiefs, mittens, towels, matches, jam, soup squares, tea, tins of butter and dripping, etc., etc. In addition to these articles, complete suits of uniform, clothing, great coats, caps, boots and shoes, have been sent to, and received by, the prisoners of war.

From the numerous grateful acknowledgments, both from prisoners of war and from the officers commanding the various medical units on active service, the ladies feel that their efforts have been greatly appreciated by those whom they have endeavoured to help.

The Committee have been very greatly assisted by various ladies of the Corps who have established "depots" in Scotland, Ireland and different parts of England for the collection of comforts.

Lieutenant-Colonel F. W. H. Davie Harris, who has very kindly acted as Treasurer for the Comforts Fund, received up to the end of December, 1915, £2,152 5s. 11d., as was shown in the balance-sheet recently published in this Journal.

The Fund has been most generously supported by the various Royal Army Medical Corps Institutes, both at home and abroad.

The ladies who have helped actively in the packing of comforts are: Lady Bruce, Mesdames Archer, Burtchaell, Birrell, Brereton, Cowan, Ellis, Fell, Ffrench, Gibbard, Harding, Harrison, Hyde, Irwin, Jenken, Lelean, Macpherson, Maher, McGrigor, Nash, Profeit, Robinson, Russell, Laureston, Scott, Treherne, Whitehead and the Misses Burnett, Bett, Mathias, Robinson and Sloggett.

Lady Sloggett and the Committee wish to thank most heartily all those who have so generously helped them in the past by donations, both in money and kind, and they hope for a continuance of their kind support to enable them to carry on this work.

Parcels of Comforts should be sent to the Secretary,

Mrs. C. K. Morgan,
"R.A.M.C. Comforts,"
Royal Army Medical College,
Grosvenor Road, London.

and cheques to,

Lieutenant-Colonel F. W. H. Davie Harris,
124, Victoria Street,
London, S.W.

LIST OF DONATIONS RECEIVED BY LIEUTENANT-COLONEL DAVIE HARRIS UP TO DECEMBER 31, 1915.

R.A.M.C., Aldershot ..	£400	0	0
,, Mess, Woolwich	105	0	0
,, Fund	100	0	0
,, Netley	81	18	0
,, Millbank ..	69	11	6
,, Chester	62	2	9
,, Tidworth ..	60	0	0
,, Limerick ..	50	0	0
,, Serjeants' Mess, Aldershot ..	50	0	0
,, Devonport ..	40	0	0
,, Eastbourne ..	31	17	0
,, Edinburgh ..	34	5	9
,, Hampstead ..	27	0	6
,, Crookham ..	25	0	0
,, Mess, London ..	20	0	0
,, Mess, Netley ..	20	0	0
,, Colchester ..	17	9	0
,, Curragh	15	0	0
,, Royal Arsenal ..	12	0	0
,, Llandrindod Wells	10	0	0
,, Fulham	9	16	6
,, Portland.. ..	7	15	0
,, Mess, Aldershot	7	0	0
,, Rochester Row..	7	0	0
,, Canterbury ..	6	10	0
,, Sling	6	4	3
,, Grantham ..	6	0	0
,, Dublin	5	5	0
,, Salisbury ..	5	0	0
,, Cosham	5	0	0
,, Woolwich ..	5	0	0
,, Chatham ..	5	0	0
,, Scarborough ..	4	12	6
,, Shorncliffe ..	3	0	0
,, Cork	3	0	0
,, King George's Hospital ..	3	0	0
,, Lewisham ..	2	13	0
,, Homerton ..	2	13	0
,, Warley	1	17	0
,, Leeds	1	8	6
,, Royal Free Hospital	0	10	0
Mrs. Fell	52	2	0
Mrs. Donnett	37	2	0
Mrs. G. Wedgewood ..	35	0	0
Mrs. Macpherson	29	10	0
Mrs. H. Scott	27	12	0
Mrs. Morgan..	26	2	7
Surg.-Gen. Bourke	26	0	0
Surg.-Gen. Sir Arthur Sloggett	25	0	0
Mrs. Harrison	25	0	0
Messrs. Holt and Co. ..	20	0	0
H. B. Bouveni, Esq. ..	20	0	0
Mrs. Woodhouse	20	0	0
Lieut.-Col. and Mrs. Davie Harris	12	13	6
Miss Sloggett	11	6	0

Surg.-Gen. Dorman.. ..	£11	0	0
Lady Keogh	10	10	0
F. Crabtree, Esq.	10	10	0
Mrs. E. L. Robinson ..	10	10	0
G. Sloggett, Esq.	10	0	0
Col. Blenkinsop	10	0	0
Mrs. Bourke	10	0	0
Capt. J. T. Clapham ..	10	0	0
Mrs. Duncan..	7	8	0
Proceeds of Concert, Uxbridge	7	0	0
Mrs. Maher	6	10	0
Proceeds of Plymouth Garrison Concert	6	6	0
Proceeds of Concert, Woolwich..	6	6	0
Lieut.-Col. E. A. Mapleton	5	5	0
G. L. Eastes, Esq., M.D. ..	5	5	0
Surg.-Gen. and Mrs. Whitehead	5	4	0
Mrs. Russell	5	5	0
H. B. Weir, Esq.	5	0	0
Col. C. R. Tyrell	5	0	0
Major and Mrs. Boylan Smith	5	0	0
Mr. and Mrs. de Rougement	5	0	0
Col. D. Sullivan	5	0	0
Major and Mrs. Brereton ..	5	0	0
Lieut.-Col. Bateson.. ..	5	0	0
S. Farmer, Esq.	5	0	0
Col. Johnston, C.B. ..	5	0	0
Mrs. M. A. Walker	5	0	0
Lieut.-Col. A. M. Coleman	5	0	0
A. M. Lamb, Esq.	5	0	0
J. Eckstein, Esq.	5	0	0
Capt. P. S. Tomlinson ..	5	0	0
Col. J. R. Dodd	5	0	0
Mrs. Babtie	5	0	0
Col. E. M. Hassard.. ..	5	0	0
Mrs. Hickman Morgan ..	5	0	0
Capt. Colin Mackenzie ...	5	0	0
Major J. Winder	5	0	0
Per Miss Sexton	4	17	6
Mrs. Bourke	4	12	6
Surg.-Gen. and Mrs. Fawcett	4	0	0
Miss Mary Sexton	3	11	0
Rochdale Women's Liberal Association	3	10	0
Mrs. Ellis	3	10	0
Capt W. Benson	3	10	0
Mrs. Douglas Hunter ..	3	5	0
H. C. Guillard, Esq. ..	3	4	6
Lt.-Col. and Mrs. Faichnie	3	3	6
Major Brereton	3	3	0
Major and Mrs. Lever ..	3	3	0
M. S. Yourrell, Esq. ..	3	3	0
Mrs. M. E. O'Dell	3	0	0
Mrs. B. R. Kay	3	0	0
Mrs. Pritchard	3	0	0
Mrs. Delap	3	0	0
Mrs. Browne..	3	0	0
Mrs. Huth	3	0	0

Mrs. M. Hay..	£3	0	0	Miss Kuth	£1	0	0
Mrs. Scott	3	0	0	Alpha	1	0	0
Mrs. T. P. Jones	2	15	0	Mrs. E. Collingwood	1	0	0
Capt. F. H. Turner..	2	12	6	W. M. Simpson, Esq.	1	0	0
Mrs. B. M. Edwards	2	11	0	Miss A. Rose	1	0	0
Mrs. A. L. Greaves	2	10	0	Lieut.-Col. A. F. Elliot	1	0	0
A. L. Greaves, Esq.	2	10	0	Miss Phyllis Sutton	1	0	0
Mrs. Haines ...	2	8	0	Mrs. O'Dell	1	0	0
Mrs. Dennis	2	5	6	Miss Bidgood	1	0	0
Lieut.-Col. Coutts	2	2	0	Dr. Howard Barrett	1	0	0
Mrs. Alexander	2	2	0	Mrs. Lamb	1	0	0
Lt.-Col. D. V. O'Connell	2	2	0	Major F. D. Elderton	1	0	0
Col. R. P. Forman	2	2	0	Lieut.-Col. G. E. Weston	1	0	0
Harold Morphew, Esq.	2	2	0	Mrs. Bullen	1	0	0
Surg.-Gen. Sir Charles Cuffe	2	2	0	Mrs. Leask	1	0	0
Major J. M. Buist	2	2	0	Mrs. Day	1	0	0
Mrs. Monty Butler	2	2	0	Surg.-Gen. Dorman	1	0	0
Norman Cayley, Esq.	2	2	0	Mrs. E. M. Ellis	1	0	0
Mrs. Geddes	2	2	0	Miss Wilson	1	0	0
Mrs. Comer	2	2	0	Lieut.-Col. H. Dunne	1	0	0
Surg.-Gen. F. J. Burnett	2	2	0	Col. T. B. A. Tuckey	1	0	0
Miss A. L. Bolton	2	0	0	R. E. Ramsden, Esq.	1	0	0
Miss Henderson	2	0	0	Mrs. Chichester	1	0	0
Colonel M. Knox	2	0	0	Miss F. Mathias	1	0	0
Lieut.-Col. and Mrs. Mould	2	0	0	Miss Gladys Hunter	1	0	0
Per Lady Sloggett	2	0	0	Lady Powell	1	0	0
Col. and Miss Murray Irwin	2	0	0	Headquarters Mess, Southern Command	1	0	0
Lieut.-Col. Dundon..	2	0	0	Mrs. E. H. Stevens..	1	0	0
Mrs. French	2	0	0	Mrs. W. K. Polter	1	0	0
Mrs. Treherne	2	0	0	Mrs. Priestley	1	0	0
Mrs. Jencken	2	0	0	Lieut.-Col. Percy Evans	1	0	0
Mrs. Freeman	2	0	0	Miss Phyllis Sutton	0	15	0
Mrs. Buswell..	2	0	0	Mrs. Morrice..	0	15	0
Mrs. Lelean	1	10	0	J. W. Papillon, Esq.	0	10	6
Mrs. Noble	1	10	0	F. S. Stanton, Esq...	0	10	6
Zenda Sisters	1	5	0	Capt. Beadnell, R.A.M.C.	0	10	6
Miss Cooke	1	5	0	Lieut. Thompson	0	10	6
A. L. Lamb, Esq.	1	1	0	Mrs. Bernard	0	10	0
Major Johnston	1	1	0	Miss E. A. Wilkinson	0	10	0
Col. Willis	1	1	0	Miss Doas	0	10	0
Cooper Patten, Esq.	1	1	0	Rev. S. Duncan Perry	0	10	0
Lieut.-Col. H. P. Birch	1	1	0	Miss Pell	0	10	0
Mrs. C. Crichton	1	1	0	Miss Helen Keitty	0	10	0
Graham Forbes, Esq.	1	1	0	Mrs. Rutherford Warren	0	10	0
Major F. O. Fitzgerald	1	1	0	Glee Party, Aldershot	0	10	0
Major G. Mansfield	1	1	0	Mrs. Noble	0	10	0
Miss Hill	1	1	0	Mrs. Shaw	0	10	0
Lieut.-Col. C. Tatham	1	1	0	Anonymous	0	8	0
Lieut.-Col. G. Bray	1	1	0	Miss E. K. White	0	5	0
E. Hay, Esq.	1	1	0	L. A. Goldney, Esq.	0	5	0
Mrs. E. B. Hill	1	1	0	Mrs. C. Clarke	0	5	0
Dr. Howard Barrett	1	1	0	Mrs. Clarke	0	5	0
Capt. T. P. Thomas	1	1	0	Mrs. Williams	0	5	0
Lieut.-Col. Corban	1	1	0	Per Mrs. Paterson	0	5	0
Mrs. Burtchaell	1	1	0	Mrs. Minmo	0	4	6
H. Gossace, Esq.	1	0	0	Mr. and Mrs. Taylor	0	4	0
Miss Clay	1	0	0	Miss Ethel Candy	0	4	0
Mrs. E. Rose	1	0	0	Mrs. Dailey	0	2	0
Col. Hughes	1	0	0				

MARRIAGE.

WHITE—HAMILTON.—On January 13, 1916, Major Charles White, Royal Army Medical Corps, third son of the late Dr. William Dudley White, to Ellen (Nell), only daughter of David Hamilton, Esq., of Ballina, co. Mayo.

DEATH.

WHITE.—Lieutenant-Colonel Thomas Henry White, M.D. (R.), died at Merton House, Christchurch Road, Reading, on January 27, 1916.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, *Serle Street, London, W.C., not later than the 22nd of the month.*

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

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				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2				
	8	0 5 0	0 2 8	4 8	1 1	3 10	0 9
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5				
	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10				
	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1				
	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5				
	8	0 15 0	0 6 7	10 10	7 6	9 0	4 10
	16	1 6 0	0 9 8				

*** These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.**

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 1s. 8d. net; binding, 1s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Lieutenant-Colonel F. E. Fremantle, Major H. T. Wilson, Captain C. Bryan, Captain M. Culpin, Captain A. F. Eagleton, Captain A. W. Falconer, Captain G. B. Gill, Captain F. Jefferson, Captain H. A. Lake, Captain C. N. Longridge, Captain A. Ryland, Captain W. Waller, Lieutenant E. K. Rideal, Lieutenant W. Wallace, Fulham Military Hospital Clinical Society.

The following publications have been received:—

British: St. Thomas's Hospital Reports, The Hospital, Tropical Veterinary Bulletin, The Medical Journal of Australia, The Lancet, The Sanitary Record and Municipal Engineering, The Medical Review, Public Health, St. Bartholomew's Hospital Journal, The Journal of Tropical Medicine and Hygiene, Annals of Tropical Medicine and Parasitology, Medical Press and Circular, The Indian Medical Journal, Proceedings of the Royal Society of Medicine, The Army Service Corps Journal, The Journal of State Medicine, Australian Military Journal, Journal of the Royal Naval Medical Service, The Medical Journal of South Africa, Tropical Diseases Bulletin, The Practitioner, The Indian Medical Gazette.

Foreign: United States Public Health Service, Revista de Sanidad Militar, United States Department of Agriculture, International Military Digest, Bulletin de l'Institut Pasteur, Bulletin of the Johns Hopkins Hospital, The Journal of Infectious Diseases, Office Internationale d'Hygiène Publique, The Russian Naval Medical Journal, United States Naval Medical Bulletin, Report of the Surgeon-General of the United States Army, 14th Annual Report of the Institute for Medical Research of the Federated Malay States.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

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JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

MARCH, 1916.

EXTRACT FROM THE "LONDON GAZETTE," FEBRUARY 22, 1916.

War Office,
February 24, 1916.

The President of the French Republic has bostowed the decoration of the Legion of Honour, with the approval of His Majesty the King, on the undermentioned Officers, in recognition of their distinguished service during the campaign.

CROIX DE COMMANDEUR.

Surgeon-General William Grant Macpherson, C.B., C.M.G., M.B., K.H.P.
Surgeon-General Tom Percy Woodhouse, C.B.
Colonel Sir William Boog Leishman, C.B., F.R.S., M.B., F.R.C.P., K.H.P., Army Medical Service.

CROIX D'OFFICIER.

Colonel Charles Henry Burtchaell, C.M.G., M.B., Army Medical Service.

CROIX DE CHEVALIER.

Major Walter Rothney Battye, D.S.O., M.B., F.R.C.S., Indian Medical Service.
Major Robert Barclay Black, M.B., Reserve of Officers, Royal Army Medical Corps.
Major James Sydney Pascoe, Royal Army Medical Corps.
Major Eugene Ryan, D.S.O., Royal Army Medical Corps.
Major John Weir West, M.B., Royal Army Medical Corps.
Captain Francis Casement, M.B., Royal Army Medical Corps.
Captain Douglas Murray McWhae, Australian Army Medical Corps.
Captain (temporary Major) John Morley, M.B., F.R.C.S., Royal Army Medical Corps (Territorial Force).
Lieutenant (temporary Captain) Joseph Wilfrid Craven, M.B., Royal Army Medical Corps (Territorial Force).

The President of the French Republic has bestowed the decoration "Croix de Guerre" on the undermentioned Warrant Officer, Non-commissioned Officer, and Men, in recognition of their distinguished service during the campaign:—

No. 2135 Corporal Essex Allen, 26th Field Ambulance, Royal Army Medical Corps (Territorial Force).
No. 7204 Bearer Beni, 128th Field Ambulance, Indian Medical Service.
No. 12519 Quartermaster-Serjeant Robert Ernest Halford, Royal Army Medical Corps.
No. 440 Private Frank Taylor, 9th Field Ambulance, Royal Army Medical Corps.

The President of the French Republic has bestowed the decoration "Médaille Militaire" on the undermentioned Warrant Officers, Non-Commissioned Officers and Men, in recognition of their distinguished service during the campaign:—

No. 1792 Private William Adamson, 3/1st Lowland Field Ambulance, Royal Army Medical Corps (Territorial Force).

No. 837 Serjeant William Brooks, 1/3rd West Riding Field Ambulance, Royal Army Medical Corps (Territorial Force).

No. 115 Quartermaster-Serjeant George Carroll, 1/3rd East Lancashire Field Ambulance, Royal Army Medical Corps (Territorial Force).

No. 980 Serjeant William D. Gibb, 89th Field Ambulance, Royal Army Medical Corps (Territorial Force).

No. 1925 Private William Marchant, Royal Army Medical Corps.

No. 32369 Serjeant Frederick John Newton, Royal Army Medical Corps.

No. 12104 Quartermaster-Serjeant John Edgar Newton, Royal Army Medical Corps.

2nd Class Assistant Surgeon Geoffrey Carl Rehling, Indian Subordinate Medical Department.

No. 18340 Staff-Serjeant Joseph Rouse, Royal Army Medical Corps.

No. 88662 Driver Edward Smith, "D" Battery, 49th Brigade, Royal Field Artillery (formerly No. 36288, Royal Army Medical Corps).

No. 19979 Corporal George Edmund Thain, Royal Army Medical Corps.

There are no restrictions as to the occasions on which any of these decorations may be worn.

The King has been graciously pleased to grant unrestricted permission to the undermentioned Officers to wear the decorations specified, which have been conferred by his Majesty the King of the Belgians, for distinguished service during the campaign:—

Surgeon-General Sir Arthur Thomas Sloggett, K.C.B., C.M.G., K.H.S., Commandeur de l'Ordre de Léopold.

Surgeon-General Robert Porter, M.B., Commandeur de l'Ordre de la Couronne.

Colonel Samuel Guise Moores, C.B., Army Medical Service, Officier de l'Ordre de Léopold.

Lieutenant-Colonel Stevenson Lyle Cummins, C.M.G., M.D., Royal Army Medical Corps, Officier de l'Ordre de la Couronne.

Lieutenant-Colonel Arthur Chopping, C.M.G., Royal Army Medical Corps, Officier de l'Ordre de la Couronne.

Distinguished Conduct Medals.

His Majesty The King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-commissioned Officers and man, for acts of gallantry and devotion to duty whilst serving with the Expeditionary Forces in France and Flanders, and at the Dardanelles. (*Supplement to the London Gazette*, No. 29296, dated September 14, 1915.)

No. 5691 Corporal G. Gallagher.

For conspicuous gallantry and devotion to duty from August 9 to 11, 1915, at Hooge, in rallying stretcher-bearers and wounded under heavy fire.

No. 20709 Serjeant J. H. Heap.

For conspicuous gallantry and devotion to duty from August 9 to 11, 1915, Hooge, in giving constant attention to the collecting wounded under heavy fire.

No. 5778 Private H. Meakins.

For conspicuous gallantry and good work throughout the campaign, notably at Hooge, on August 9, 1915, when he gave great assistance to the Medical Officer under heavy shell fire, and when alone in the trenches worked hard all day tending the wounded and dressing their wounds.

The Director-General in recognition of the credit which these gallant actions reflect on the individuals concerned, and on the Corps, has directed that the Private shall be promoted to the rank of Corporal when a vacancy occurs.

Mentioned in Despatches.

The names of the following Warrant and Non-commissioned Officers of the R.A.M.C. were mentioned in the Despatch from the Commander-in-Chief, Mediterranean Expeditionary Force, in the *Supplement to the London Gazette*, No. 29354, of November 5, 1915:—

No. 10431 Serjeant-Major H. Underwood, No. 16177 Serjeant-Major A. F. Robinson, No. 2166 Serjeant W. T. Mathias, No. 1643 Serjeant F. H. Mattock, No. 31656 Serjeant B. T. Colls, No. 19254 Acting-Serjeant G. A. Scales.

The names of the following Warrant Officers, Non-commissioned Officers and men of the R.A.M.C. were mentioned in the Dispatch from the Field-Marshal Commanding-in-Chief the British Army in France, which was published in the *Supplement to the London Gazette*, No. 29422, of December 31, 1915 :—

No. 10665 Serjeant-Major H. J. Angell, No. 17843 Quartermaster Serjeant R. C. Blair No. 13338 Serjeant-Major H. S. Boxshall, No. 10076 Acting Serjeant-Major W. H. Browne, No. 13027 Serjeant-Major J. B. Cantrell, No. 10573 Serjeant-Major W. H. Chudleigh, No. 8417 Acting Serjeant-Major J. Davis, No. 15670 Serjeant-Major F. W. Goodread, No. 11565 Serjeant-Major J. H. Jones, No. 10073 Serjeant-Major W. Merchant, No. 14705 Serjeant-Major W. A. Muirhead, No. 9747 Acting Serjeant-Major C. Williams, No. 15288 Quartermaster-Serjeant W. C. Prince, No. 18415 Quartermaster-Serjeant A. Bell, No. 18445 Quartermaster-Serjeant J. E. Crawley, No. 18678 Quartermaster-Serjeant L. S. Ellis, No. 16053 Quartermaster-Serjeant S. M. Gawthorne, No. 12519 Quartermaster-Serjeant R. E. Halford, No. 18216 Quartermaster-Serjeant R. G. Legget, No. 18718 Quartermaster-Serjeant W. H. Parr, No. 11527 Quartermaster-Serjeant T. C. Prewett, No. 18645 Quartermaster-Serjeant C. E. Rouse, No. 13187 Quartermaster-Serjeant F. Sparks, No. 17633 Quartermaster-Serjeant R. Sproule, No. 15843 Quartermaster-Serjeant W. Stokes, No. 14359 Quartermaster-Sergeant J. G. Thomas, No. 18973 Staff-Serjeant J. J. Abbott, No. 12986 Staff-Serjeant E. Alexander, No. 17794 Staff-Serjeant W. A. Beckett, No. 14072 Staff-Serjeant R. R. Benham, No. 18226 Staff-Serjeant L. V. Bilbee, No. 764 Staff-Serjeant R. Boddy, No. 19595 Staff-Serjeant C. E. Bull, No. 17696 Staff-Serjeant S. Collins, No. 11392 Staff-Serjeant E. Connor, No. 17844 Staff-Serjeant W. A. Clenshaw, No. 17870 Staff-Serjeant E. Cragg, No. 12264 Staff-Serjeant W. G. Delamare, No. 1905 Staff-Serjeant J. G. Eves, No. 8137 Staff-Serjeant T. French, No. 16325 Staff-Serjeant A. F. Gibbs, No. 2147 Staff-Serjeant W. C. Hampson, No. 1097 Staff-Serjeant R. Herbert, No. 17427 Staff-Serjeant L. Higgins, No. 18383 Staff Serjeant M. W. Hutchings, No. 19747 Staff-Serjeant C. H. Hyde, No. 16442 Staff Serjeant W. Lawson, No. 19558 Staff-Serjeant T. Lythgoe, No. 1951 Serjeant F. J. R. Money (Acting Staff-Serjeant), No. 19732 Staff-Serjeant H. Mayes, No. 19933 Staff-Serjeant W. C Savegar, No. 18737 Staff-Serjeant W. T. Stovold, No. 12676 Staff-Serjeant E. A. Young, No. 5235 Serjeant G. H. Bottom, No. 17151 Serjeant J. T. Brown, No. 7742 Corporal G. Burdett (Acting Serjeant), No. 19419 Serjeant W. G. W. Clark, No. 2221 Serjeant G. Coleman, No. 7345 Corporal W. J. Collins (Acting Serjeant), No. 2245 Serjeant A. G. Cripps, No. 18545 Serjeant J. Douglas, No. 1914 Serjeant E. Dugmore, No. 15389 Serjeant G. Dunn, No. 19039 Serjeant J. T. Emerson, No. 4357 Serjeant T. H. Harding, No. 17379 Serjeant E. Hardy, No. 20478 Serjeant J. W. Hastings, No. 10634 Serjeant F. Horn, No. 18312 Serjeant J. Howitt, No. 18019 Serjeant J. G. Julyan, No. 12344 Serjeant F. H. Lucas, No. 1808 Serjeant W. J. McClay, No. 20007 Serjeant G. Oliver, No. 19126 Serjeant F. H. Perkins, No. 12059 Corporal J. B. Purvis (Acting Serjeant), No. 1764 Serjeant H. W. Selden, No. 18799 Corporal V. Smith (Acting Serjeant), No. 4405 Serjeant E. F. Taylor, No. 34 Serjeant F. C. Weare, No. 12691 Corporal W. Ahearn, No. 12796 Corporal R. Atkinson, No. 5739 Corporal H. P. Bird, No. 18221 Private G. W. Bradford (Acting Corporal), No. 1862 Corporal G. A. Doyle, No. 12047 Corporal H. A. Ely, No. 5964 Corporal J. A. Hewitt, No. 1270 Corporal F. G. Marrable, No. 19937 Corporal G. T. Platford, No. 1999 Private A. Pullen (Acting Corporal), No. 4919 Private T. Roberts (Acting Corporal), No. 6125 Corporal A. J. Sage, No. 2167 Corporal A. J. Stirk, No. 12781 Corporal W. Walton, No. 20706 Lance-Corporal A. Avery, No. 4088 Private C. A. Banyard (Acting Lance-Corporal), No. 13654 Private F. Clapton (Acting Lance-Corporal), No. 7533 Private V. H. Andrews, No. 387 Private F. Bailey, No. 6658 Private F. J. Baxter, No. 11044 Private F. Best, No. 19971 Private E. J. Biggins, No. 4889 Private W. O. Browne, No. 5701 Private F. G. Bush, No. 3523 Private C. Capes, No. 18021 Private J. Carleton, No. 6534 Private R. W. Cathrine, No. 257 Private R. J. Coles, No. 3699 Private G. H. Cotterell, No. 6552 Private W. Craib, No. 2769 Private E. Dew, No. 1339 Private H. Dodsworth, No. 13311 Private G. Dunlop, No. 949 Private G. Falkner, No. 1390 Private T. Hackett, No. 1491 Private G. Harding, No. 7898 Private W. R. Harris, No. 20620 Private W. Henry, No. 8443 Private W. T. Herrick, No. 19027 Private J. Higham, No. 12433 Private C. A. T. Hughes, No. 1379 Private W. Hughes, No. 7639 Private H. Kearney, No. 730 Private T. Kelly, No. 6296 Private R. Laws, No. 7539 Private F. Leakey, No. 20340 Private J. Ludlow, No. 1925 Private W. Marchant, No. 8333 Private W. H. Marklew, No. 19402 Private

G. Marsh, No. 4131 Private R. G. Meades, No. 1371 Private G. Mercer, No. 298 Private R. New, No. 8303 Private J. W. Nicholson, No. 8676 Private M. Ogden, No. 6989 Private W. Orme, No. 5220 Private J. Peacock, No. 9266 Private R. Pemberton, No. 6753 Private J. Reed, No. 4420 Private G. O. Richards, No. 5605 Private A. T. Rose, No. 1768 Private R. R. Sturrock, No. 948 Private W. Smith, No. 20061 Private E. Strangeways, No. 9007 Private R. Treglown, No. 18472 Private G. Waller, No. 9024 Private E. Walton, No. 8368 Private F. G. Whitbread, No. 4315 Private L. Whitaker, No. 7478 Private A. Y. Williamson, No. 6587 Private C. Wright, No. 30923 Staff-Serjeant C. B. Symes, No. 46289 Serjeant J. Cooper, No. 30754 Serjeant H. E. Fawden, No. 33545 Serjeant J. Fenton, No. 40035 Serjeant C. K. Grigg, No. 37869 Serjeant H. Langley, No. 39276 Serjeant J. P. Makeham, No. 39253 Serjeant J. A. Stoney, No. 46285 Serjeant E. Suckling, No. 42835 Corporal W. Strachan, No. 35693 Corporal W. J. Twidell, No. 45522 Private E. W. Bowsher, No. 58310 Private J. R. Bray, No. 35727 Private C. J. Brooks, No. 30417 Private T. H. Brooke, No. 39894 Private G. Browne, No. 49333 Private R. Buckly, No. 34625 Private T. Foreman, No. 45591 Private T. Gray, No. 51058 Private M. Hardingham, No. 8035 Private C. E. Heywood, No. 46205 Private J. Lewis, No. 45453 Private J. Masters, No. 42025 Private J. Morris, No. 37162 Private W. Owen, No. 47213 Private C. M. H. Richardson, No. 51679 Private V. T, Roberts, No. 45183 Private H. Saunders, No. 46951 Private H. Scandrett, No. 41992 Private H. Shaw, No. 45670 Private W. Valentine, No. 58313 Private S. W. White, No. 31113 Private F. W. Woolnough.

ARMY MEDICAL SERVICE.

Temporary Lieutenant-Colonel Peter B. Giles, C.B., Royal Army Medical Corps, to be temporary Colonel, from September 1, 1915, to December 31, 1915.

Lieutenant-Colonel Charles W. Profeit, M.B., to be temporary Colonel whilst an Assistant Director of Medical Service, dated January 3, 1916.

The name of Lieutenant-Colonel (temporary Colonel) F. R. Buswell is as now described and not as in the *Gazette* of January 6, 1916.

Lieutenant-Colonel George F. Gubbin, retired pay, from Deputy Assistant Director of Medical Services, to be Assistant Director of Medical Services, 1st London Division, with the temporary rank of Colonel, dated February 11, 1916.

ROYAL ARMY MEDICAL CORPS.

Lieutenant-Colonel Michael O'Halloran is retained on the Active List under the provisions of Articles 120 and 522 Royal Warrant for Pay and Promotion, and to be supernumerary, dated February 18, 1916.

Temporary Honorary Lieutenant-Colonel Robert T. Leiper, M.B., to be temporary Lieutenant-Colonel, dated February 14, 1916.

Major Charles H. Straton to be temporary Lieutenant-Colonel whilst commanding 39th Field Ambulance, from November 6 to December 6, 1915.

Daniel Robert O'Sullivan-Beare, M.B., to be temporary Lieutenant-Colonel, dated January 1, 1916.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst in command of Field Ambulances :—

Dated August 15, 1915.—Patrick J. Hanafin.

Dated December 7, 1915.—Edward H. M. Moore.

Dated January 18, 1916.—Temporary Major Charles S. Myers, M.D.

The undermentioned temporary Captains to be temporary Majors :—

From October 7 to November 5, 1915, Allan N. Minns, whilst commanding 39th Field Ambulance.

Dated January 7, 1916.—Robert Dunmore Hotchkiss, M.D.

Dated February 1, 1916.—Robert H. Cooper.

Dated February 5, 1916.—Aylmer William May, M.D.

Dated February 18, 1916.—Frank A. A. Holmden, D.S.O., M.B.

The undermentioned Majors are retained on the Active List, under the provision of Articles 120 and 522, Royal Warrant for Pay and Promotion :—

Dated January 31, 1916.—Edgar E. Powell ; Walter A. S. J. Graham.

Charles Henry Milburn, M.B., to be temporary Honorary Major whilst serving with No. 2 British Red Cross Hospital, dated January 19, 1916.

Temporary Major Bernard E. Myers, M.D., relinquishes his commission on appointment to the New Zealand Medical Corps, dated February 1, 1916.

Major Robertson S. Smyth, M.D., retires on a gratuity, dated February 22, 1916.

Captain Charles H. Gregory, M.D., from 1st Home Counties Field Ambulance, to be Deputy Assistant Director of Medical Services, Home Counties Division, dated February 15, 1916.

Surgeon Captain Alfred C. Lupton, M.B., 1st Life Guards, Half-pay List, retires on retired pay, dated November 22, 1915. (Substituted for the notification which appeared in the *Gazette* of November 29, 1915.)

Temporary Captain Fred W. Mackenzie, M.B., is placed temporarily on retired pay on account of ill-health, dated February 11, 1916.

Captain Andrew Baxter, M.D., from Attached to Units other than Medical Units, to be Deputy Assistant Director of Medical Services, 1st Mounted Division, dated January 18, 1916.

James Ewing (late Captain, 1st West Riding Field Ambulance, and late temporary Captain, Royal Army Medical Corps) to be Captain and Deputy Assistant Director of Medical Services, 3rd Army, Central Force, dated January 25, 1916.

The name of temporary Lieutenant Archibald Stodart-Walker, M.B., is as now described and not as in the *Gazette* of October 1, 1915.

Transport Officer and Honorary Lieutenant John L. Hamilton resigns his commission, dated January 13, 1916.

The undermentioned to be temporary Captains:—

Dated July 11, 1915.—Captain Brereton George Elliott, The East Lancashire Regiment, Territorial Force.

Dated August 16, 1915.—Captain James Matthews Duncan Scott, M.B., South African Medical Corps.

Dated September 25, 1915.—William Burrough Cosens.

Dated November 11, 1915.—Temporary Lieutenant Andrew Gilmour, M.D.

Dated December 22, 1915.—James Robert Hall Walker, M.D., late temporary Captain, Indian Medical Service.

Dated December 30, 1915.—Major Edward Provan Cathcart, M.D., from the Unattached List of the Territorial Force.

Dated January 1, 1916.—Morgan James Rees, M.D.

Dated January 3, 1916.—Francis Arthur Bainbridge, M.D.

Dated January 7, 1916.—Temporary Honorary Captain Bernard Constable Mayberry, M.B., F.R.C.S.

Dated January 8, 1916.—Walter Evelyn James; Hugh Bernard German, late Surgeon, Royal Navy; Temporary Lieutenant Raymond Brewitt-Taylor, M.B.

Dated January 11, 1916.—Temporary Captain Samuel Jervois Scott, from Princess Victoria's (Royal Irish Fusiliers); Harold Dey Gillies, F.R.C.S.

Dated January 17, 1916.—George Graham, M.D.

Dated January 17, 1916.—Robert Sewers Berry, late temporary Captain, Royal Army Medical Corps.

Dated January 19, 1916.—John Rutter Williamson, M.D., late temporary Captain Indian Medical Service.

Dated January 28, 1916.—Ernest Black.

Dated February 1, 1916.—Lieutenant Andrew Daniel Clinch, M.D., from Dublin University Officers Training Corps; Russell Henry Jocelyn Swan, M.B., F.R.C.S.

Dated February 7, 1916.—John Stuart Ross, M.B., F.R.C.S.Edin.

Dated February 22, 1916.—Temporary Lieutenant Alexander Scott, M.B., late Surgeon, Royal Navy.

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated December 2, 1915.—Frederick Barnes; George L. Leggat, M.B.

Dated December 7, 1915.—James M. Barkley, M.B.; Sidney J. Ormond, M.D.

Dated December 10, 1915.—Robert Marshall, M.B.; John Stephenson, M.B.; Robert M. Boyd, M.B; Edwin Kidd, M.B.

Dated December 15, 1915.—James M. Rishworth, M.B.; William R. S. Watkins, M.B., F.R.C.S.Edin.

Dated December 20, 1915.—Thomas J. L. Thompson, M.B.

Dated December 28, 1915.—Charles H. Nash.

Dated December 30, 1915.—Frederick D. Walker, M.B.

Dated January 1, 1916.—Robert H. Hutchinson.

Dated January 7, 1916.—Thomas L. Llewellyn, M.D.; Bernard C. Ewens; Dudley Forde, M.D.; James D. Finlay, M.B.

Dated January 11, 1916.—Henry S. de Boer; George A. C. Gordon, M.B.

Dated January 15, 1916.—Douglas Green, M.B., F.R.C.S.; Cecil Banting, M.D., F.R.C.S.; Walter Winslow, M.B.; Arthur C. D. Firth, M.D.; Claude H. Philips; Thomas J. Kelly; Clive J. H. Sharp, M.B.; Charles F. O. White; Ernest S. Dixon, M.B.

Dated January 16, 1916.—William Pritchard-Airey; James Morrison, M.B.; Dominic F. Curran; John H. Glover, M.B.

Dated January 17, 1916.—Harry Armstrong; Guido De P. D'Amico, M.D.

Dated January 18, 1916.—James C. Dunn, M.D.; Wilfred C. S. Wood; Donald Watson, M.B.; George A. Maling, V.C., M.B.; Leonard A. P. Burt, M.B.; Samuel R. Mackenzie, M.D.

Dated January 19, 1916.—Robert N. Geach, F.R.C.S.

Dated January 20, 1916.—Archer Ryland, F.R.C.S.Edin.; Charles J. Glasson, M.D.; Henry W. Doll; Charles P. MacCormack.

Dated January 21, 1916.—James Tate, M.B.; William A. Taylor, M.D.; Arthur W. H. Donaldson, M.B.; John F. Venables, M.B.; Edward B. Sunderland; Clive W. Roe; Frank C. Greig; John P. Blockley, M.B.; Desmond W. Beamish; William Leslie, M.B.; James Parker; Cyril C. Beatty; William A. Brown, M.B.; Reginald H. Fothergill, M.B.; Desmond M. MacManus; Ulick J. Bourke; Horace N. Everard, M.D.; George C. Adeney, M.B., F.R.C.S.; Henry S. C. Hooper; Arthur Poole, M.B.; Gerald Robinson; Robert W. Murphy, M.D.

Dated January 22, 1916.—James Hill, M.B.; William G. Ridgway, F.R.C.S.I.; Robert A. Wright; Bevil M. Collard; Thomas J. R. Maguire, M.B.; Bertram H. Barton, M.D.; G. F. Barr, M.B.

Dated January 24, 1916.—Peter H. MacDonald, M.B.

Dated January 25, 1916.—Charles L. Wigan, M.B.; John C. Robb, M.B.; William S. Heron, M.B.; Roger MacGrath, M.B.; Cedric N. Vaisey; Leslie A. Drake, M.B.

Dated January 26, 1916.—George O. Jacobsen; Martin P. Thomas; George M. De Vines, M.B.; Henry J. Cotter; Thomas S. Goodwin, M.B.

Dated January 27, 1916.—John S. Prentice, M.B.; William J. A. B. Wishart, M.B.

Dated January 28, 1916.—James P. Lavery; Josiah R. Turner, M.B.; Walter S. Lindsay, M.B.; George Davidson, M.B.; George T. Cregan, M.B.

Dated January 30, 1916.—Hubert S. Stockton; Charles de C. Pellier; John R. McGilvray, M.P.

Dated February 1, 1916.—Geoffrey Fildes, M.B.; Henry W. S. Wright; Edmund C. Malden; William K. A. Richards; Charles Roche; John W. Gilbert; Sidney H. Browning; Kenneth Playfair; James H. Bampton, M.B.; Frederick R. Harris; Thomas A. Watson, M.D.; Thomas L. Enright; Henry H. Weekes, M.D.; Arthur H. Wilson; Arthur G. P. Hardwick; William J. B. Selkirk, M.D.; Robert M. Fraser; William D. Dunlop, M.B.; Thomas H. F. Roberts; David Wilson, M.B.; George W. B. James, M.D.; Bernard R. Parmiter, M.B.; James W. McKinney, M.B.; Ernest Tawse, M.B.; James D. Forrester, M.B.; Graham Smith; Arthur R. Wightman, M.B.; Reginald A. Morrell; Sidney B. Radley, M.B., F.R.C.S.; Lomond C. Dillon-Kelly; Cecil F. Dillon-Kelly; Eugene P. Leahy, M.B.; Robert Tindall, M.B.; Robert H. Liscombe, M.B.; Frank L. Cleland, M.B.; Archibald Fullerton, M.B.; Ernest E. Herga; William A. Coats, M.B.; Theodore E. Roberts; Richard R. Armstrong, M.B.; John A. F. Hatch.

Dated February 2, 1916.—Malcolm Gross; Arthur W. Comber; William Anderson, M.B., F.R.C.S.Edin.; George A. Shiel.

Dated February 3, 1916.—Duncan M. Morison, M.B.; Matthew H. Fleming.

Dated February 4, 1916.—Maurice Nicoll, M.B.; Claude E. Freeman; Herbert Smith, M.B.; William B. Sanders, M.B.; David J. Jones, M.B.; Charles H. G. Prance.

Dated February 5, 1916.—Horace J. Gater; George G. Bartholomew, M.B.

Dated February 6, 1916.—Walter R. Knightley; Philip M. Heath, F.R.C.S.; Harold C. Harrison; Alfred E. Seller.

Dated February 7, 1916.—Archibald Cowe, M.B.; John E. Davis; John C. Neil, M.B.; William MacLeod; Oliver B. Pratt; Tom W. Wadsworth, M.D.; Edward H. Fennessy, M.B.; Stanley T. Lewis, M.B.; Drevor F. A. Neilson; Harold V. Lamb; Leonard H. Terry.

Dated February 8, 1916.—Percy L. T. Bennett; John H. Boag, M.B.; William F. MacAlevey; Kenneth M. Nelson; Arthur H. Towers, M.B.; Henry S. Turner; Philip P. Warren; Patrick W. White, M.B.; Hugh G. Morris, M.B.; Maxwell Ramsey, M.B.

Dated February 9, 1916.—Charles R. Nicholson; John R. Lee, M.D., F.R.C.S.Edin.; Daniel V. M. Adams, M.B., Reserve of Officers.

Dated February 10, 1916.—Thomas P. Devlin, late Captain, Royal Field Artillery, Territorial Force.

Dated February 22, 1916.—Hugh H. Highet, M.D.

Temporary Honorary Lieutenant Oswald G. Morgan, to be temporary Honorary Captain whilst serving with No. 9 British Red Cross (Duchess of Sutherland's) Hospital, dated February 9, 1916.

Temporary Honorary Lieutenant Arthur C. Inman, M.B., to be temporary Honorary Captain, dated February 10, 1916.

The undermentioned to be temporary Lieutenants :—

Antedated to August 14, 1915.—Alexander G. Waddell, M.B.

Dated December 10, 1915.—James Aimer Thomas, M.B.

Dated December 25, 1915.—Charles Cooper.

Dated January 7, 1916.—William Hackett Broughton.

Dated January 12, 1916.—William Murdoch Buchanan, M.B.; Malcolm Campbell, M.D.; William Paul, M.B.; William Speedy, M.B.; Reginald Arthur Warters, M.B.; Gerald Fitzgerald, M.B.; Alexander Dryden Moffat, M.B.; John Joseph Clarke; Reginald Ernest Illingworth; Arthur Douglas Hunt, M.D.; David Robertson Taylor, M.B.; Alexander William Mather, M.B.; Archibald Campbell Tait; Cecil William Clements Robinson.

Dated January 13, 1916.—Edwin Lionel Christoffelsz.

Dated January 14, 1916.—James Gorges Massey Molony; Angus Dugald Buchanan, M.B.; Norman Alexander Boswell, M.B.; William Douglas Denton Small, M.D.; Robert Morton Hewitt, M.D.; John Phillips Fairley; Raymond Montgomery, M.D.

Dated January 15, 1916.—Leonard Thomason Giles, M.B., F.R.C.S.; Harold Clement Fox, M.B.; Ernest William Martin, M.B.; Charles Sangster Rivington; William Martin Muirhead, M.B.; Ernest Hugh Cameron, M.B., F.R.C.S.Edin.; John Bain, M.B.; William Bracewell Mercer, M.B.; Ralph Reynell Watts, M.B.; Charles Morton Gavin Elliott; Nathaniel Graee, M.D.

Dated January 17, 1916.—Samuel Stockman, M.B.; Frederick William Craig, M.B.; James Oag, M.B.; Archibald McLelland Pilcher, M.B.; Harold Norman Ingham, M.B.; Francis Joseph Eager; Percy George Temple; James Ferguson St. John Annesley, M.D.; Alexander Hogg Donaldson, M.B.: James McFarlane Grier, M.B.

Dated January 18, 1916.—Herbert W. Fankhausen, M.B.; Stanislaus Reader; Harold Wordsworth Barber, M.B.; Edward Cyril Sparrow, M.B.; Adalbert Henry Ernst; Roy Neville Craig.

Dated January 19, 1916.—Albert Harold Godwin Burton, M.D.

Dated January 20, 1916.—William George Porter, M.D.; John Alexander Macarthur, M.B.; William Martin Nairn, M.B.; James Whiteford Potter, M.B.; James N. G. W. McMorris.

Dated January 21, 1916.—Frank L. Gill, M.B.; Patrick Steele, M.D.; Arthur Whittome, M.B., F.R.C.S.Edin.; Ernest Godfrey Wheat, M.D.

Dated January 24, 1916.—John Perrin Brown, M.B.; Harold Edward Whittingham, M.B.; John MacNamara; Douglas Swan Robertson, M.B.; John Herbert Crangie Fegan; Herbert Evelyn Allanson, M.D.; James McConnell, M.B.

Dated January 25, 1916.—Robert Younger, M.B.; Alex John Lincoln Speechly; Grosvenor Titzell Leyburne Murphy, M.B.; William Baird Grandison; Leonard Dinnis; Leonard Smith; Joseph Blair Syson; Thomas Keen Place.

Dated January 26, 1916.—Thomas Henry Agnew; Arthur Neville Cox, M.D.; Hugh Emrys Williams, M.B.; James Gaymer Jones.

Dated January 27. 1916.—Arthur Sunderland; Alban Wilson.

Dated January 28, 1916.—Lawrence Gameson, M.B.; Percy Reginald O'Rourke Phillips.

Dated January 29, 1916.—Herbert de Lisle Crawford, M.B., F.R.C.S.I.; William Watkiss Jones, M.B.

Dated February 1, 1916.—Cecil Brian Forsayeth Tivy, M.B.; Henry Vincent Forster, M.B.; Joseph Bamworth, M.D.; Ernest Edward Semmence; George Hart; Joseph Nunan, M.B.; David Smith, M.B.; Arthur Wentworth Jones; Patrick Raoul Eskell; John Wilson Tonks, M.B., F.R.C.S.; John Shepley Part, M.D.; Donald James Clark, M.B.; Legh Richmond Herbert Peter Marshall, M.D.; George Gray Buchanan, M.B.; Wilfrid Garton; Hugh Mundle Wilson, M.B.; Reginald Harold Bridge, M.B. F.R.C.S.; Frederick Mark Davies; James Lang Cochrane, M.B.; Robert Coltart Harkness, M.B., F.R.C.S.; John Agar Matson, M.D.; Joseph Edmund Mullan; George Jackson, M.B.; John Arthur Fretton; Edmund Walker Neill Hobhouse, M.B.; John Godfrey Slade, M.D.; George Philip Sheehan; John William

Edward Cole, M.B.; Daniel Joseph O'Brien: Ewald Mouat Balthasar; William Wilfrid Halsted; George Edward Anderson; Herbert Rees Davies, M.D.; Harry Nimmo Rankin, M.B.; Gideon Robert Ernest Colquhoun; Thomas Francis Moran; William Stuart McGowan, M.D.; John Primrose Douglas, M.B., Daniel Henry Foley; Lionel Frederick West; Francis Joseph MacManus; Thomas Wilson Ruttledge, M.B.; Percival Garmany Leeman, M.B.; Francis Hugh McCaughey, M.B.; Charles Heywood Seville, M.B.; Claude Hastings George Philp, M.B; Robert Norman Hartley; George Frederick Columb Healy, M.D.; William Griffith Jones; John Kenneth Garner.

Dated February 2, 1916.—Howard Vivian Alexander Gatchell.

Dated February 3, 1916.—Henry George Carlisle, M.D.; Harold Turner Finlayson, M.B.; James Williamson; Scott Potter; Francis J. Browne, M.B., F.R.C.S.Edin.

Dated February 4, 1916.—George Macdonald, M.B.; Ernest William Gilmore Young, M.B.; Thaddeus Turner O'Callaghan; James Stirling Crawford, M.D.; James William Littlejohn, M.D.; Claude Evelyn Sharp, M.D.

Dated February 7, 1916.—Eric Slack, M.B.; Henry Bouchier-Hayes; John Michael O'Reilly, M.B.; Herbert McWilliams Daniel, M.B.; Alfred Purvis Hart, M.B.; David Mackenzie Hunt; John Penman, M.B.; Arthur Nicholas Whistler Colahan, M.B.; Harry Stobie; William Owen Roberts; Geoffrey Stanhope Robinson, M.B.; Robert Nichol, M.B.; James Ewen Cable, M.B.: John Edward Sheppard Sheppard-Jones; Gilbert Heathcote; Edward Howard Wood, M.B.; Hugh Peace Caithness, M.B.; Arthur Savill Burgess, M.B.; William Aikman Muir, M.D.; Duncombe Steele Steele-Perkins.

The notification concerning William H. Broughton, which appeared in the *Gazette* of February 4, 1916, is cancelled.

The undermentioned to be temporary Lieutenants whilst employed as Dental Surgeons:—

Dated January 13, 1916.—Lieutenant Herbert Henry Belsey, from 1st County of London (Middlesex, Duke of Cambridge's Hussars) Yeomanry, Territorial Force.

Dated January 17, 1916.—Louis Edward Tracey Forster; Wilfred Moss; Andrew Jeffrey Leitch.

Dated January 18, 1916.—George Macphee.

Dated January 20, 1916.—Lawrence Charles Crockett; James Wells Graham; William Stanley Rutter; Harold Graham Elliott.

Dated January 22, 1916.—Bernard Robert Townend.

Dated January 24, 1916.—Andrew Jupp; William Waddell Boyd; Ernest Victor Jones.

Dated February 3, 1916.—Alexander Reid Inglis.

Dated February 5, 1916.—Arnold John Chapman.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants:—

Dated December 22, 1915.—Richard Proctor, M.D.; Gordon Stuart Clancy, M.D.

Dated January 1, 1916.—George Orville Scott; Clifford Maunsell Scott.

Dated January 15, 1916.—Morley Counsellor Bridgman, M.D.; Alfred McNally, M.B.; Albert Ernest McCulloch, M.B.; George Joseph Hanley, M.D.; Clarence Bain Cameron, M.D.; William George Granville Coulter; William Dixon, M.B.; John Edwin Bromley, M.D.; Charles Gordon Merrick; Garnet Harvey Kearney, M.D.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated January 12, 1916.—Edward James Clark, M.B.

Dated January 13, 1916.—Wilfred John Pearson, M.B.

Dated January 14, 1916.—Charles Fellowes Maclachlan.

Dated January 18, 1916.—Francis Keene Marriott; Eric Gordon Barker; George William Huggins.

Dated January 19, 1916.—Robert Burns Eadie, M.B.

Dated January 21, 1916.—James Stuart Leslie; Thomas Chalmers Bowie, M.B.

Dated January 24, 1916.—Basil Graves.

Dated February 4, 1916.—George Charles Berg; Charles Hugh Colclough Byrne.

Dated February 7, 1916.—Philip Hudson.

The undermentioned to be Honorary Lieutenants:—

Dated January 5, 1916.—William Ronald White-Cooper.

Dated February 7, 1916.—Thomas Baillie Johnston, M.B.; Vincent Coram James.

Dated February 9, 1916.—Robert Hood Fleming, M.B.

Dated February 12, 1916.—Harold Arthur Whyte-Venables; Patrick Arthur Dargan.

Dated January 23, 1916. —Henry Ward Bennett, M.B.

Dated January 24, 1916.—Herman Lewis; Lionel Meredith Davies.

The undermentioned are granted temporary honorary rank whilst serving with the Scottish Red Cross Society:—

Dated February 24, 1916.—As Captains: Charles McNeil, M.D., F.R.C.P.Edin.; Denis Cotterill, M.B., F.R.C.S.Edin. As Lieutenants: Henry Torrance Thomson, M.D.; Disney Hubert Dusch Cran, M.B.

The undermentioned to be temporary Honorary Lieutenants whilst serving with the St. John Ambulance Brigade Hospital:—

Dated January 14, 1916.—Sydney Alexander Henry, M.D.; Charles Eric Sweeting Jackson, M.B., F.R.C.S.; William Wilson, M.B.

The undermentioned temporary Captains relinquish their commissions: Robert S. Berry (dated December 16, 1915); James Ewing (dated January 5, 1916); Charles J. Edgar, M.D. (dated January 20, 1916); Cyril G. Whorlow (dated January 25, 1916); Edward L. Middleton, M.B. (dated February 1, 1916); Hector Munro, M.B. (dated February 9, 1916); Alfred H. James (dated February 10, 1916); Frank A. Cooke, M.D. (dated February 12, 1915).

The undermentioned temporary lieutenants relinquish their commissions: Alfred E. Townley, M.B. (dated January 1, 1916); Henry F. Smith, M.D. (dated January 7, 1916); William M. Thomas, Thomas Marron, M.B. (dated January 10, 1916); Cyril A. Smallhorn, M.B. (dated January 12, 1916); Arthur F. G. Codd, M.B., F.R.C.S. (dated January 15, 1916); John H. Glover, M.B. (dated January 16, 1916); William C. Burns (dated January 21, 1916); Alexander F. W. Millar, M.B. (dated January 25, 1916); John Ellison, M.B. (dated January 27, 1916); Frederick P. Walsh, Alexander N. Craig, M.B. (dated February 1, 1916); Adrian St. Johnston (dated February 3, 1916); Griffith L. Jones, Arthur J. B. Leckie, M.D. (dated February 8, 1916); Reginald L. E. Downer, M.D. (dated February 15, 1916); George Reid, M.B., Walter Wiglesworth (dated February 22, 1916).

Temporary Lieutenant Herbert Malins, M.B., F.R.C.S.Edin., relinquishes his commission on account of ill-health (dated February 22, 1916).

The undermentioned relinquish their temporary honorary commissions on ceasing to serve with the St. John Ambulance Brigade Hospital:—

Dated January 14, 1916.—Captain F. W. Goyder, M.B., F.R.C.S. Lieutenants: W. R. Mason, M.D.; H. de L. Crawford, M.B., F.R.C.S.I.; A. C. McAlister.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant:—

Dated January 24, 1916.—Frederick William Norvill.

Dated January 26, 1916.—George Arthur Rayment Withey.

Dated February 1, 1916.—John Duignan; Edmund Mousell Mitchell.

Dated February 3, 1916.—Temporary Quartermaster and Honorary Lieutenant John W. Mayne relinquishes his commission on account of ill-health.

Queen Alexandra's Imperial Military Nursing Service.

Matron Miss M. Wilson, R.R.C., to be Principal Matron, dated December 26, 1915.

Sister Miss A. B. Wohlmann, to be Matron, dated December 26, 1915.

Staff Nurse Miss A. M. Rice resigns her appointment, dated January 30, 1916.

TERRITORIALS.

Royal Army Medical Corps.

1st East Anglian Field Ambulance.—Captain Theophilus W. Morcom-Harneis, from Attached to Units other than Medical Units, to be Captain, dated February 22, 1916; Lieutenant John E. Brooks to be Captain, dated December 16, 1915.

2nd East Anglian Field Ambulance.—Norman M. Smith, M.B., dated January 6, 1916; William J. Wilkinson, dated January 20, 1916; William J. Dearden, dated January 21, 1916.

3rd East Anglian Field Ambulance.—Captain (temporary Major) John R. Pooler, M.B., to be temporary Lieutenant-Colonel whilst Commanding a Field Ambulance, dated December 24, 1915.

1st *Southern General Hospital.*—Lieutenant Charles B. Hawthorne to be Captain, dated January 15, 1916; John Millard, dated January 19, 1916.

4th *Southern General Hospital.*—Captain Guy S. Earle, M.D., relinquishes his commission on account of ill-health, dated February 24, 1916.

1st *Home Counties Field Ambulance.*—Reginald Henry Hardwick to be Lieutenant, dated February 2, 1916; Transport Officer and Honorary Lieutenant Albert Victor Epps resigns his commission, dated February 19, 1916.

2nd *Home Counties Field Ambulance.*—Captain Horace C. Barr, from Attached to Units other than Medical Units, to be Captain, dated February 11, 1916.

1st *Wessex Field Ambulance.*—Captain James Gray Macindoe, M.B., to be Major, dated September 29, 1915.

2nd *Wessex Field Ambulance.*—Captain Henry W. Spaight, from Half-pay List, to be Captain, dated February 17, 1916.

Wessex Casualty Clearing Station.—Captain Arthur Cecil Alport, M.B., South African Medical Corps Reserve, to be Captain, dated December 9, 1915. The dates of appointment of the undermentioned Lieutenants are as now stated, and not as announced in the *London Gazette* of November 11, 1915, and October 9, 1915: Charles Telfer, dated August 24, 1915; Thomas James Wright, dated September 13, 1915.

1st *London (City of London) General Hospital.*—Lieutenant-Colonel Archibald E. Garrod, M.D., is seconded, dated November 15, 1915; Lieutenant John D. L. Currie to be Captain, dated December 17, 1915.

1st *London (City of London) Field Ambulance.*—William R. H. Heddy, to be Captain dated January 2, 1916; Transport Officer and Honorary Lieutenant Cuthbert H. Withers resigns his commission, dated January 22, 1916.

1st *London (City of London) Sanitary Company.*—The undermentioned Lieutenants to be Captains: John O. W. Barratt, M.D., dated December 25, 1915; Horace G. Moss, dated December 29, 1915; Norman A. Dore, dated December 29, 1915; John Teare, M.B., to be Lieutenant, dated February 3, 1916; Frederick Ernest Woodham Rogers, to be Lieutenant, dated February 3, 1916; William John Fitzgerald Mayne, M.B. (late temporary Lieutenant, Royal Army Medical Corps), dated February 19, 1916; Arthur Frank Girvan, dated February 19, 1916; William Campbell Lyons, M.B., dated February 24, 1916.

2nd *London (City of London) Field Ambulance.*—Clement Perronet Sells, dated February 22, 1916; Transport Officer and Honorary Lieutenant Edward S. Jones resigns his commission, dated January 22, 1916.

2nd *London Sanitary Company.*—Lieutenant James Mair, M.B., to be Captain, dated November 24, 1915: Samuel Summerson to be Lieutenant, dated February 3, 1916; Edwin Paul Wheeler, to be Lieutenant, dated February 3, 1916; Lieutenant Sidney L. Bartholomew relinquishes his commission on account of ill-health, dated February 19, 1916.

2nd *London Casualty Clearing Station.*—Lieutenant Hamilton Drummond, M.B., to be Captain, dated January 16, 1916.

3rd *London General Hospital.*—The following announcement is substituted for that which appeared in the *London Gazette* of January 22, 1916: Arthur Kingsford to be Captain, whose services will be available on mobilization, dated August 18, 1915.

3rd *London (City of London) Field Ambulance.*—Transport Officer and Honorary Lieutenant William A. Chapman resigns his commission, dated January 22, 1916.

4th *London General Hospital.*—John Abernethy Willett, M.D., to be Lieutenant, dated October 1, 1915.

4th *London Field Ambulance.*—Lieutenant-Colonel Mowbray Taylor, M.B., relinquishes is commission on account of ill-health, dated February 10, 1916.

6th *London Field Ambulance.*—Captain Daniel D. Brown, M.D., from Attached to Units other than Medical Units, to be Captain, dated February 19, 1916.

London Mounted Brigade Field Ambulance.—Transport Officer and Honorary Lieutenant Henry J. T. Neilson resigns his commission, dated January 22, 1916.

1st *Northern General Hospital.*—The undermentioned Lieutenants to be Captains: Alfred John Watson Stephen, M.B., dated January 13, 1915; Reginald Arthur Hooper, M.B,, dated January 14, 1916.

2nd *Northern General Hospital.*—The undermentioned Lieutenants to be Captains:

Walter Longley, dated November 28, 1915; Isa C. Marshall, M.D., dated January 11, 1916.

1st Scottish General Hospital.—Lieutenant Frederick W. C. Brown, M.B., to be Captain, dated February 2, 1916.

1st Highland Field Ambulance.—Captain Hugh G. Bruce, M.B., from Attached to Units other than Medical Units, to be Captain, dated January 13, 1916; Captain Charles A. Whyte, relinquishes his commission on account of ill-health, dated February 20, 1916.

2nd Highland Field Ambulance.—Lieutenant (temporary Captain) James A. Stephen, M.B., to be Captain, dated April 1, 1915.

The undermentioned Lieutenants to be Captains: Alexander M. Baillie, M.B., dated January 29, 1916; Harry G. Donald, M.B., dated January 30, 1916; John W. McKeggie, M.B., dated January 31, 1916; James A. Sellar, M.B., dated February 7, 1916; William C. D. Wilson, dated February 12, 1916.

1st Lowland Field Ambulance.—Robert Watson, to be Lieutenant, dated February 10, 1916.

2nd Lowland Field Ambulance.—Robert Kyle, M.D., dated January 27, 1916.

3rd Northumbrian Field Ambulance.—Transport Officer and Honorary Lieutenant George W. Brown, resigns his commission, dated February 13, 1916.

Welsh Border Mounted Brigade Field Ambulance.—Major John B. Yeoman, M.D., F.R.C.S., from Army Medical Service, to be Major, dated November 16, 1915; Lieutenant Haldane C. Gilmore, to be Captain, dated January 11, 1916.

Welsh Casualty Clearing Station.—Allan Wise Clarke to be Lieutenant, dated December 1, 1915.

1st West Lancashire Field Ambulance.—Captain Ernest W. Reed, M.B., from Attached to Units other than Medical Units, to be Captain, dated December 23, 1915.

The date of appointment of William C. Griffiths, as Quartermaster with the honorary rank of Lieutenant, is January 5, 1916, and not as previously stated.

2nd West Lancashire Field Ambulance.—Quartermaster-Serjeant Joseph John Llewellin to be Quartermaster, with the honorary rank of Lieutenant, dated November 29, 1915; Transport Officer and Honorary Lieutenant John W. G. Steel resigns his commission, dated February 8, 1916.

3rd West Lancashire Field Ambulance.—Captain Frederick W. K. Tough, F.R.C.S., from Attached to Units other than Medical Units, to be Captain, dated September 16, 1915.

West Lancashire Casualty Clearing Station.—Lieutenant Thomas Aspinall to be Captain, dated January 12, 1916; Serjeant Alan Kelson Deane to be Quartermaster, with the honorary rank of Lieutenant, dated January 30, 1916.

Lieutenant Edward M. de Jong, from Attached to Units other than Medical Units, to be Lieutenant, dated February 2, 1916.

Yorkshire Mounted Brigade Field Ambulance.—Lieutenant Arthur M. Deane, to be Captain, dated April 15, 1915; Lieutenant Joseph C. Denvir, M.B., to be Captain, dated December 7, 1915.

2nd South Midland Mounted Brigade Field Ambulance.—Charles Pearse Crodacott Sargent, to be Lieutenant, dated February 23, 1916.

2nd South Midland Field Ambulance.—Lieutenant Ernest J. C. Groves, M.B., to be Captain, dated April 1, 1915; Lieutenant Ernest J. C. Groves, M.B., is restored to the establishment, dated January 11, 1916.

North Midland Casualty Clearing Station.—Clement Cooke, M.B., to be Lieutenant, dated December 28, 1915; Norman Hammond Hill, to be Lieutenant, dated December 30, 1915.

Notts and Derby Mounted Brigade Field Ambulance.—Lieutenant John Wootton Rammell to be Captain, dated December 21, 1915; Walter Bailey-Thomson, M.B., dated January 1, 1916; David W. Griffiths, dated January 22, 1916.

1st South Western Mounted Brigade Field Ambulance.—Transport Officer and Honorary Lieutenant William Cecil Aylmer Jollands, resigns his commission, dated February 3, 1916.

3rd Western General Hospital.—Lieutenant Evan W. Richards, M.B., to be Captain, dated February 4, 1916.

South Eastern Mounted Brigade Field Ambulance.—Captain William Tresawna, M.B., is seconded for duty with 8th Battalion, The Middlesex Regiment, dated August 2, 1915.

1*st Eastern General Hospital.*—The date of appointment of Serjeant-Major Harry McIntyre as Quartermaster, with the honorary rank of Lieutenant, is January 1, 1916, and not as previously stated.

The undermentioned Captains to be temporary Majors whilst commanding 40th Field Ambulance:—
Dated October 13-28, 1915.—Alexander Glen, M.B.
Dated October 29, 1915.—Edmund T. Burke, M.B.
Dated April 1, 1915.—Lieutenant Matthew W. Paterson, to be Captain, with seniority next below O. H. Mavor. (Substituted for the notification which appeared in the *Gazette* of July 26, 1915.)

The undermentioned Lieutenants to be Captains:—
Dated January 7, 1916.—William J. Dowling, M.B.
Dated January 10, 1916.—Andrew R. F. Clarke, M.B.; Andrew J. Horne, M.B.; Norman L. Reis, M.B.; Cyril E. H. Gater; Douglas C. Pim, M.B.; Frederick R. S. Shaw, M.B.
Dated January 16, 1916.—Ribton G. Blair, M.B.; Francis R. H. Mollan; George Stanton, M.B.; John D. Proud.
Dated January 19, 1916.—Thomas W. E. Elliott, M.B.; John O'S. Beveridge, M.B.; Arthur J. Beveridge, M.B.; Samuel D. Lodge; Charles H. Bennan.
Dated January 21, 1916.—Edwin N. H. Gray.
Dated January 22, 1916.—John A. Musgrave.
Dated January 24, 1916.—Thomas McClurkin, M.B.; Thomas Menzies, M.B.; Robert S. Cumming, M.B.; Douglas H. Murray, M.B.; William A. Thompson, M.B.; James McKay, M.B.; Raymond Stowers; Reginald O. Eades; Rudolph A. Peters, M.B.
Dated January 26, 1916.—Walter B. Foley.
Dated January 28, 1916.—David Dempster, M.B.; Thomas Y. Barkley.
Dated February 3, 1916.—Robert G. McElney, M.B.; Ian G. M. Firth; Christopher G. Schurr; John W. Malcolm, M.B.; John S. Armstrong, M.B.
Dated February 7, 1916.—Edgar S. Rowbotham; Oswald D. Jarvis, M.B.
Dated February 10, 1916.—John A. Binning; Samuel Brown.
Dated February 14, 1916.—James Melvin, M.B.; John E. Rusby.

Lieutenant Charles G. Todd resigns his commission on account of ill-health, dated February 17, 1916.
Lieutenant (on probation) George T. Gimlette is confirmed in his rank.
Lieutenant (on probation) Wyndham Williams, M.B., is confirmed in his rank.
Lieutenant (on probation) Thomas E. B. Beatty is confirmed in his rank.
John Kerr Ritchie Landells to be Lieutenant (on probation), dated September 6, 1914. (Substituted for the notification which appeared in the *Gazette* of September 23, 1914.)

Attached to Units other than Medical Units.

Captain Samuel Martyn, M.B., to be Major, dated August 1, 1915.
Lieutenant Sidney Hughes, to be Captain, dated October 7, 1915.
George Wishart McIntosh, M.B. (late Captain 7th Battalion, The Black Watch (Royal Highlanders)), to be Major, dated October 16, 1915.
Lieutenant Francis J. Davidson to be Captain, dated November 21, 1915.
James Lilwall Cormac, to be Lieutenant, dated December 7, 1915.
Lieutenant Arthur B. Winder, M.D., to be Captain, dated December 10, 1915.
Lieutenant Robert V. C. Ash, M.B., dated December 12, 1915.
Lieutenant Alfred G. Osborn, M.B., dated December 27, 1915.
Captain Robert Lindsay, M.B., to be Major, dated January 2, 1916.
Richard Ernest Williamson, M.B. (late Lieutenant-Colonel, 6th Battalion, The Duke of Wellington's (West Riding Regiment)), dated January 18, 1916.
Major James Gray Macindoe, M.B., from 1st Wessex Field Ambulance, dated February 1, 1916.
Major Thomas Beard resigns his commission on account of ill-health, dated February 8, 1916.

Captain Henry E. McCready, M.D., from 1st South Midland Field Ambulance, to be Captain, dated February 12, 1916.

Captain Basil Hughes, M.B., F.R.C.S., from 1st West Riding Field Ambulance, dated February 20, 1916.

Maitland Thompson to be Lieutenant, dated February 22, 1916.

Special Corps Order.

Promotions.

Authority has been received from the War Office to readjust the seniority of the undermentioned Non-commissioned Officers as follows, but without pay:—

No. 15484 Serjeant C. Jones, to be Staff-Serjeant, dated August 10, 1914; No. 17736 Serjeant J. D. Keeble, to be Staff-Serjeant, dated August 10, 1914; No. 17730 Serjeant P. Wills, to be Staff-Serjeant, dated August 10, 1914; No. 12819 Serjeant W. H. Riches, to be Staff-Serjeant, dated August 10, 1914.

Also for the following promotions consequent on the above with pay from October 25, 1915:—

To be Quartermaster-Serjeants.—No. 15484 Staff Serjeant C. Jones, dated March 1, 1915, with seniority next below No. 18801 Quartermaster-Serjeant G. H. Wolfe; No. 17736 Staff-Serjeant J. D. Keeble, dated June 1, 1915. with seniority next below No. 17057 Quartermaster-Serjeant M. Ward; No. 17730 Staff-Serjeant P. Wills, dated June 1, 1915, with seniority next below No. 17057 Quartermaster-Serjeant M. Ward: No. 12819 Staff-Serjeant W. H. Riches, dated June 15, 1915, with seniority next below No. 14761 Quartermaster-Serjeant W. Robertson.

To be Serjeants.—Authority has been received from the War Office for the promotion of the undermentioned Corporals to the rank of Serjeant from December 23, 1915, to rank for seniority as Serjeants without pay from January 20, 1915, as shown below:—

No. 1973 Corporal W. Elliott, with seniority next below No. 1969 Serjeant G. W. Overton; No. 2150 Corporal E. G. Fraser, with seniority next below No. 2148 Serjeant J. Ashcroft; No. 4936 Corporal H. E. Strange, with seniority next below No. 4935 Serjeant W. Andrews; No. 4368 Corporal C. Hardy, with seniority next below No. 2245 Serjeant A. G. Cripps; No. 5796 Corporal W. V. Dixon, with seniority next below No. 5281 Serjeant A. Jerred; No. 5901 Corporal J. Rowley, with seniority next below No. 5281 Serjeant A. Jerred.

The following promotions to complete War Establishment will take effect from the dates specified:—

To be Serjeant-Major.—No. 9578 Quartermaster-Serjeant W. Dawson, dated October 5, 1915.

To be Quartermaster-Serjeant.—No. 10385 Staff-Serjeant F. Howe, dated October 5, 1915.

To be Staff-Serjeant.—No. 19079 Serjeant E. G. Stoneham, dated October 5, 1915.

To be Serjeants.—No. 4310 Corporal F. H. Tomlyn, dated October 2, 1915, special as Clerk; No. 19640 Corporal G. H. Hollands, dated October 5, 1915, special as Clerk; No. 1791 Corporal P. G. Elsey, dated October 16, 1915, special as Clerk; No. 1759 Corporal J. H. Meenagh, dated October 16, 1915, special as Clerk.

To be Corporals.—No. 5578 Private H. Meakins, dated September 28, 1915, in accordance with Corps Order No. 80 of this date; No. 19131 Private S. J. Weeks, dated October 1, 1915; No. 19462 Private S. E. Dunn, dated October 2, 1915; No. 19486 Private W. J. French, October 5, 1915; No. 2127 Private A. E. G. Marsh, dated October 12, 1915; No. 18776 Private A. T. Speller, dated October 16, 1915; No. 5789 Private E. T. Eggs, dated October 16, 1915; No. 6123 Private J. Delaney, dated October 16, 1915; No. 7161 Private J. W. Price, dated October 20, 1915, No. 7742 Private G. Burdett, dated October 24, 1915; No. 12365 Private W. L. Brodie; dated October 27, 1915.

To be Quartermaster-Serjeants. — No. 12588 Staff-Serjeant J. Meason, dated February 6, 1915, with seniority next below No. 13187 Quartermaster-Serjeant F. Sparks; No. 8510 Staff-Serjeant W. H. Butler, dated January 2, 1916.

To be Corporals.—No. 1000 Private B. S. Franklin, dated December 9, 1915, in accordance with Corps Order No. 1 of this date; No. 12432 Private A. Ward, January 2, 1916; No. 17842 Private E. Ainsworth, dated January 3, 1916; No. 17926 Private J. F. Winter, dated January 3, 1916; No. 19784 Private H. J. Davey, dated January 8, 1916; No. 5321 Private W. Graham, dated January 8, 1916, for meritorious

service whilst a Prisoner of War; No. 12433 Private C. A. T. Hughes, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 19807 Private E. J. Murphy, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 440 Private F. Taylor, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 478 Private R. Symes, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 1502 Private F. Bennison, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 4093 Private J. Grundy, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 3311 Private W. Hanson, dated January 12, 1916, in accordance with Corps Order No. 2 of this date; No. 4919 Private T. Roberts, dated January 14, 1916, in accordance with Corps Order No. 2 of this date; No. 5367 Private A. J. Weston, dated January 20, 1916, in accordance with Corps Order No. 2 of this date; No. 365 Private F. McGarry, dated January 21, 1916, in accordance with Corps Order No. 2 of this date; No. 20747 Private H. Wallis, dated January 21, 1916, in accordance with Corps Order No. 2 of this date; No. 20852 Private H. Wilkinson, dated January 23, 1916, in accordance with Corps Order No. 2 of this date; No. 10363 Private G. Kilpack, dated January 25, 1916, in accordance with Corps Order No. 2 of this date; No. 9027 Private P. T. Pronger, dated January 25, 1916, in accordance with Corps Order No. 2 of this date; No. 6220 Private J. S. Kerr, dated January 28, 1916, in accordance with Corps Order No. 3 of this date.

These promotions are subject to the conditions laid down in paragraph 35, Standing Orders, R.A.M.C., 1914.

Award of Army Form C. 344.

The undermentioned have been awarded Army Form C. 344 on completion of three years' training in accordance with paragraph 330, Standing Orders, on the dates specified:—

No. 15484 Staff-Serjeant C. Jones, dated September 22, 1915; No. 5901 Corporal J. Rowley, dated September 22, 1915; No. 1270 Corporal F. G. Marrable, dated September 22, 1915; No. 6235 Corporal G. L. Green, dated October 4, 1915; No. 5390 Corporal D. C. Tait, dated October 6, 1915; No. 4904 Private J. Lawson, dated October 16, 1915; No. 5578 Private J. Bannon, dated October 18, 1915; No. 6097 Private E. L. Portsmouth, dated October 25, 1915; No. 934 Corporal T. Giles, dated October 27, 1915; No. 6217 Corporal C. Schoenthal, dated November 6, 1915; No. 4870 Corporal S. Poules, dated December 14, 1915; No. 5796 Corporal W. V. Dixon, dated December 27, 1915; No. 5290 Corporal E. Hadfield, dated January 19, 1916.

Nursing Section.

The following appointments to the Nursing Section of the Corps will take effect from the dates specified:—

No. 2125 Private F. Freed, dated September 17, 1915; No. 10707 Private H. Oldacre, dated September 17, 1915; No. 2550 Private R. Kane, dated September 17, 1915; No. 3510 Private J. Clayton, dated September 17, 1915; No. 10699 Private A. T. Jones, dated September 17, 1915; No. 3519 Private J. Russell, dated September 17, 1915; No. 3525 Private E. Wright, dated September 17, 1915; No. 2554 Private W. McKeown, dated September 17, 1915; No. 3999 Private H. Porter, dated September 17, 1915; No. 3110 Private E. Newman, dated September 17, 1915; No. 7483 Private W. Taylor, dated September 17, 1915; No. 7888 Private E. Gates, dated September 17, 1915; No. 3229 Private W. J. Adams, dated September 17, 1915; No. 3516 Private S. McCullough, dated September 17, 1915; No. 10588 Private A. L. Meads, dated September 17, 1915; No. 5424 Private G. G. McLardie, dated September 17, 1915; No. 6626 Serjeant J. Metcalf, dated September 18, 1915; No. 9140 Private W. Barnett, dated September 20, 1915; No. 9300 Private N. Gearty, dated September 20, 1915; No. 7874 Private C. Haden, dated September 20, 1915; No. 1162 Private A. Hoare, dated September 20, 1915; No. 8936 Private F. C. Jackson, dated September 20, 1915; No. 9417 Private J. Johnstone, dated September 20, 1915; No. 7894 Private E. Rodney, dated September 20, 1915; No. 8369 Private W. G. Sterry, dated September 20, 1915; No. 10130 Private C. Thorpe, dated September 20, 1915; No. 19954 Private E. R. Tipton, dated September 20, 1915; No. 2977 Private P. H. Avery, dated September 24, 1915; No. 16923 Private J. Chesters, September 24, 1915; No. 3751 Private T. H. Lacey, dated September 25, 1915; No. 7656 Private F. G. Jordan, dated September 25, 1915; No. 19869 Private T. Baston, dated September 25, 1915; No. 7571 Private J. Garland, dated September 25, 1915; No. 7008 Private J. J. Cahill, dated September 25, 1915;

No. 3817 Private P. Craven, dated September 25, 1915; No. 4141 Private R. Walters, dated September 25, 1915; No. 11324 Private D. Cousins, dated September 27, 1915; No. 10913 Private W. E. Court, dated September 27, 1915; No. 10971 Private P. G. H. Martin, dated September 27, 1915; No. 10804 Private R. Waterworth, dated Seps tember, 27, 1915; No. 11279 Private C. E. Wynde, dated September 27, 1915; No. 10632 Private C. Webster, dated September 27, 1915; No. 20850 Private P. Thomas, dated September 28, 1915; No. 10663 Private C. Holloway, dated September 29, 1915. No. 7463 Private E. Bowler, dated September 29, 1915; No. 5875 Private R. S. Goring; dated September 29, 1915; No. 6921 Private W. Andus, dated September 29, 1915; No. 7457 Private C. W. Nuttall, dated September 29, 1915; No. 7453 Private G. H, Williams, dated September 29, 1915; No. 7779 Private E. F. Barnes, dated September 29, 1915; No. 4994 Private G. W. Beer, dated September 29, 1915; No. 15799 Private T. E. Pearce, dated September 29, 1915; No. 7440 Private W. F. Welbeloved, dated September 29, 1915; No. 6048 Private C. Wooderson, dated September 29, 1915; No. 20834 Private S. A. Johns, dated September 29, 1915: No. 20111 Private E. A. Williams, dated September 29, 1915; No. 20405 Private W. Johns, dated September 29, 1915; No. 7494 Private C. Ryan, dated October 4, 1915; No. 1737 Private R. Glenton, dated October 9, 1915; No. 1447 Private P. Conway, dated October 9, 1915; No. 7897 Private J. A. Maloney, dated October 9, 1915; No. 7891 Private F. C. Stringer, dated October 9, 1915; No. 10654 Private J. P. Dickson, dated October 9, 1915; No. 10664 Private A. Jevons, dated October 9, 1915; No. 1334 Private J. T. Austen, dated October 9, 1915; No. 9572 Private J. L. Thomson, dated October 9, 1915; No. 7974 Private H. L. Hanson, dated October 9, 1915; No. 10812 Private R. O. Bridger, dated October 14, 1915; No. 10153 Private G. Bordill, dated October 14, 1915; No. 10677 Private C. Tozer, dated October 14, 1915; No. 19798 Private W. H. Boister, dated October 16, 1915; No. 5651 Private A. J. T. Wakeford, dated October 16, 1915; No. 6886 Private J. Swarbrick, dated October 18, 1915; No. 5980 Private R. S. St. Clair, dated October 18, 1915; No. 7113 Private A. Tomlinson, dated October 18, 1915; No. 2733 Private F. F. Oldershaw, dated October 18, 1915; No. 2521 Private R. A. King; dated October 18, 1915; No. 19124 Private T. W. Brier, dated October 18, 1915, No. 798 Private W. Thomas, dated October 20, 1915; No. 929 Private W. Townsend, dated October 20, 1915; No. 20722 Private T. Dilworth, dated October 21, 1915; No. 20697 Private R. Mooney, dated October 21, 1915; No. 20730 Private T. Birch, dated October 21, 1915; No. 20535 Private E. Greathead, dated October 21, 1915; No. 20050 Private J. Eckersley, dated October 21, 1915; No. 20793 Private T. Bradshaw, dated October 21, 1915; No. 20711 Private J. H. Buller, dated October 21, 1915; No. 20626 Private T. Atherton, dated October 21, 1915; No. 10155 Private G. Baker, dated October 21, 1915; No. 10120 Private W. J. Bradfield, dated October 21, 1915; No. 20691 Private J. Davenport, dated October 21, 1915; No. 20833 Private W. Jacques, dated October 21, 1915; No. 20151 Private E. Jones, dated October 21, 1915; No. 20012 Private H. Smith, dated October 21, 1915; No. 20196 Private W. J. Wright, dated October 21, 1915; No. 20189 Private F. Smith, dated October 21, 1915; No. 20699 Private J. Wetton, dated October 21, 1915; No. 20693 Private J. H. Wilson, dated October 21, 1915; No. 20439 Private E. Spedding, dated October 21, 1915; No. 20049 Private F. Bayley, dated October 21, 1915; No. 2098 Private E. E. Taylor, dated October 23, 1915; No. 1896 Private V. Dow, dated October 23, 1915; No. 1965 Private S. F. Downing, dated October 23, 1915; No. 6491 Corporal L. Jones, dated November 1, 1915; No. 15759 Private E. A. Kempson, dated November 3, 1915; No. 18479 Private W. Burgess, dated November 8, 1915; No. 7660 Private J. H. Fisher, dated November 8, 1915; No. 2387 Private W. Francis, dated November 16, 1915; No. 2664 Private J. C. Harper, dated November 16, 1915; No. 10766 Private H. H. Smart, dated November 19, 1915; No. 7413 Private C. W. Turland, dated November 19, 1915; No. 8750 Private J. Emson, dated November 19, 1915; No. 7750 Private F. B. Howe, dated November 19, 1915; No. 7751 Private C. Mercer, dated November 19, 1915; No. 10493 Private J. O'Callaghan, dated November 19, 1915; No. 5404 Private G. G. Goodman, dated November 19, 1915; No. 20729 Private W. Clough, dated November 19, 1915; No. 4985 Private A. Russell, dated November 23, 1915; No. 6022 Private G. V. Witt, dated November 25, 1915; No. 4064 Private F. W. Dent, dated November 25, 1915; No. 6977 Private C. E. Loxton, dated November 25, 1915; No. 6760 Private W. Paull, dated November 25, 1915; No. 7472 Private A. Rountree, dated December 1, 1915; No. 10952 Private T. C. McClean, dated December 2, 1915; No. 20332 Private R. Davies, dated December 3, 1915; No. 4881 Private H. Gibbons, dated December 3, 1915; No. 14352 Private J. Hudson, dated December 3, 1915; No. 709 Private F. J. Wakeman, dated December 3, 1915; No. 4714 Private J. H. Wilson, dated December 9, 1915;

No. 4696 Serjeant A. E. Phillips, dated December 9, 1915; No. 668 Private W. G. Fayers, dated December 11, 1915; No. 2267 Private F. W. Parsons, dated December 13, 1915; No. 5779 Private J. Murphy, dated December 13, 1915; No. 3699 Private G. H. Cotterell, dated December 17, 1915; No. 6967 Private C. Cross, dated December 17, 1915; No. 7542 Private W. G. Hervey, dated December 17, 1915; No. 7539 Private F. Leakey, dated December 17, 1915; No. 3724 Private R. McEvoy, dated December 17, 1915; No. 7536 Private A. Pooley, dated December 17, 1915; No. 5919 Private E. F. Newman, dated December 17, 1915; No. 10474 Private W. Brown, dated December 18, 1915; No. 6545 Private E. V. McIntyre, dated December 18, 1915; No. 10717 Private J. C. Reed, dated December 18, 1915; No. 10381 Private A. Richardson, dated December 18, 1915; No. 10537 Private W. Whitehouse, dated December 18, 1915; No. 10263 Private P. Wiggins, dated December 18, 1915; No. 3877 Private W. Bonner, dated December 18, 1915; No. 2906 Private A. Clarke, dated December 20, 1915; No. 2547 Private J. W. Ward, dated December 20, 1915; No. 7236 Private S. W. Harvey, dated December 20, 1915; No. 6380 Private F. J. Farley, dated December 28, 1915; No. 10589 Private W. G. Richards, dated December 30, 1915; No. 10561 Private R. Shepherd, dated December 30, 1915; No. 10536 Private H. Walker, dated December 30, 1915; No. 10269 Private T. F. Cooper, dated December 30, 1915; No. 10848 Private F. Barnes, dated December 30, 1915; No. 10734 Private A. J. Addy, dated December 30, 1915; No. 2434 Private F. Gurr, dated January 3, 1916; No. 10213 Private A. Smith, dated January 3, 1916; No. 6969 Private J. Harle, dated January 3, 1916; No. 7848 Private A. Hutt, dated January 3, 1916; No. 6933 Private C. Kitchen, dated January 3, 1916; No. 19526 Private J. J. Prout, dated January 3, 1916; No. 9915 Private D. B. Mitchell, dated January 8, 1916; No. 10040 Private A. G. Minchington, dated January 8, 1916; No. 10134 Private S. Sayer, dated January 8, 1916; No. 10034 Private N. Callander, dated January 8, 1916; No. 5957 Private G. Raymond, dated January 8, 1916; No. 10107 Private H. G. Turland, dated January 8, 1916; No. 10099 Private F. Murray, dated January 8, 1916; No. 10146 Private T. J. Flanagan, dated January 8, 1916; No. 10111 Private R. M. Thomas, dated January 8, 1916; No. 2716 Private R. Halley, dated January 8, 1916; No. 9912 Private F. Thompson, dated January 8, 1916; No. 4504 Private A. S. Dixon, dated January 8, 1916; No. 20860 Private J. C. Field, dated January 8, 1916; No. 4521 Private A. G. Clark, dated January 14, 1916; No. 6912 Private T. Crampton, dated January 14, 1916; No. 7028 Private A. E. Empleton, dated January 14, 1916; No. 17710 Private W. Gregory, dated January 14, 1916; No. 4014 Private A. Harris, dated January 14, 1916; No. 799 Private G. Hepenstall, dated January 14, 1916; No. 6822 Private W. J. Lawley, dated January 14, 1916; No. 7147 Private H. Moss, dated January 14, 1916; No. 6611 Private R. W. Northey, dated January 14, 1916; No. 2691 Private W. H. Robinson, dated January 14, 1916; No. 3408 Private G. Shiels, dated January 14, 1916; No. 7574 Private E. Webb, dated January 14, 1916; No. 20523 Private H. L. Bishop, dated January 14, 1916; No. 20494 Private D. C. Hoddinott, dated January 14, 1916; No. 7685 Corporal J. Cartwright, dated January 14, 1916; No. 15762 Private S. Craggs, dated January 14, 1916; No. 7088 Private C. Lynch, dated January 14, 1916; No. 12465 Private H. Young, dated January 14, 1916; No. 9773 Private L. F. Turner, dated January 14, 1916; No. 10550 Private W. H. Hastings, dated January 14, 1916; No. 12103 Private T. R. Brenton, dated January 14, 1916; No. 7722 Private L. Clowes, dated January 14, 1916; No. 10491 Private A. Martin, dated January 14, 1916; No. 5313 Private A. W. Crowther, dated January 14, 1916; No. 10652 Private F. H. Browne, dated January 14, 1916; No. 12512 Private H. Taylor, dated January 14, 1916; No. 215 Private S. F. Iles (re-appointed), dated January 14, 1916; No. 16434 Private G. R. Taylor, dated January 14, 1916; No. 17667 Private C. Redley, dated January 15, 1916; No. 2411 Private S. T. W. Langford, dated January 15, 1916; No. 6358 Private E. Collins, dated January 17, 1916; No. 20138 Private J. H. Coldwell, dated January 19, 1916; No. 20036 Private J. P. Dale, dated January 19, 1916; No. 20682 Private T. F. Fisher, dated January 19, 1916; No. 20061 Private E. Strangeways, dated January 19, 1916; No. 20059 Private J. W. Padden, dated January 19, 1916; No. 20735 Private J. W. Salmon, dated January 19, 1916; No. 23 Private C. G. Conn, dated January 21, 1916; No. 1246 Private G. Anderson, dated January 21, 1916; No. 19840 Private A. E. Haynes (re-appointed), dated January 21, 1916; No. 4090 Private P. H. Johnson, dated January 21, 1916; No. 20472 Private L. Collins, dated January 21, 1916; No. 12642 Private W. Mellors, dated January 21, 1916; No. 11826 Private G. Probert, dated January 24, 1916; No. 16857 Private F. Smith, dated January 11, 1916; No. 12426 Private R. W. H. Beaumont, dated January 14, 1916; No. 10746 Private P. Green, dated January 27, 1916; No. 9576 Private A. F. Summerfield, dated January 27, 1916;

No. 2396 Private M. Conway, dated January 27, 1916; No. 7644 Private F. Sandever, dated January 27, 1916; No. 7626 Private J. M. Barnett, dated January 27, 1916; No. 7623 Private E. Hands, dated January 27, 1916; No. 7634 Private W. H. Tuck dated January 27, 1916; No. 10088 Private H. J. Brown, dated January 27, 1916; No. 10093 Private F. Hall, dated January 27, 1916; No. 6722 Private W. Thorne, dated January 27, 1916; No. 19274 Private J. W. Motley, dated January 27, 1916; No. 732 Private E. Bountiff, dated January 27, 1916; No. 4011 Private A. Evans, dated January 27, 1916.

Advancement of Privates (Corps Pay).

The following advancements in rate of Corps Pay will take effect from November 18, 1915:—

To be Advanced to the Third Rate (at 8d.).

As Orderlies.—No. 6772 F. Griffith, No. 5180 W. J. Jones, No. 2208 S. H. Lake, No. 6750 M. Mooney, No. 13173 J. R. Bilcase, No. 6425 G. Wheeler, No. 14457 J. McCann, No. 1650 W. B. Ridewood, No. 5958 I. Kerslake, No. 4329 R. S. Wilkin, No. 1338 A. Kemp, No. 19225 W. H. Thompson, No. 1607 W. T. Pond, No. 19810 F. C. Cooke, No. 18027 A. A. Dean, No. 6370 R. W. Webber, No. 5524 H. Owen, 4801 H. Jackson, No. 19562 R. M. Wright, No. 4429 R. Beck, No. 1933 F. C. Radford, No. 6141 J. H. W. Compton, No. 5440 J. R. Price, No. 204 W. S. Arnott, No. 2 W. H. Southwell, No. 5977 W. F. Dodge, No. 20018 O. J. Rodgers, No. 20401 C. A. Nash, No. 1925 W. Marchant, No. 2747 W. Lolley, No. 18006 G. Wenford, No. 5939 W. J. Green, No. 367 E. L. Finch, No. 6518 T. G. Smith, No. 6261 F. Edge, No. 6262 E. H. J. Lovegrove, No. 787 C. Clement, No. 4377 S. J. Lovegrove, No. 2741 J. H. Haynes, No. 19214 S. S. Parker, No. 6872 C. J. Price, No. 4375 R. Tice, No. 14858 J. W. Hughes, No. 17168 F. Powell, No. 7107 C. W. Stanley, No. 5571 J. A. Taylor, No. 20585 L. A. Thomas, No. 20691 J. Davenport, No. 965 E. S. Tear, No. 5400 S. R. Brinicombe, No. 18012 H. Strawbridge, No. 6791 J. Fletcher.

As Clerks.—No. 6070 J. Martin, No. 18522 E. E. Fielder, No. 5847 E. W. Diplock, No. 5676 A. Jacobs, No. 6929 R. D. Tait, No. 931 J. Haines, No. 7091 J. Copley, No. 5170 H. Knott, No. 10694 R. S. Ellwood, No. 7144 E. P. Cooper.

As Cook.—No. 4572 F. Dixon.

To be Advanced at the Fourth Rate (at 6d.).

As Orderlies.—No. 10971 P. G. H. Martin, No. 10804 R. Waterworth, No. 11279 C. E. Wynde, No. 10632 C. Webster, No. 7246 T. Hickey, No. 20850 P. Thomas No. 10663 C. Holloway. No. 7494 C. Ryan, No. 2550 R. Kane, No. 3229 W. J. Adams, No. 10588 A. L. Meads, No. 7904 T. Bray, No. 6363 L. M. Herbert, No. 7620 G. Kirkwood, No. 10812 R. O. Bridger, No. 10153 G. Bordill, No. 10677 C. Tozer, No. 6499 T. Gillam, No. 6886 J. Swarbrick, No. 7113 A. Tomlinson, No. 2733 F. F. Oldershaw, No. 2521 R. A. King, No. 5094 G. Wilson, No. 19124 T. W. Brier, No. 7195 T. Brownlow, No. 7470 H. Neale, No. 6653 M. Jones, No. 4509 N. H. Simmons, No. 15759 E. A. Kempson, No. 7347 A. J. Friend, No. 6715 J. Dorland, No. 3283 J. F. Foy, No. 10035 S. J. Ingram, No. 7021 R. W. Tilley, No. 20345 S. R. Richards, No. 7903 G. Bates, No. 1895 S. Bulleid, No. 1210 S. Watford, No. 2241 G. H. Windle, No. 5953 R. F. Tait, No. 5345 A. E. Pullen, No. 6331 W. E. H. C. Fairfield, No. 2977 E. H. Avery, No. 5245 W. Betts, No. 16923 J. Chesters, No. 402 A. Sebeck, No. 6198 J. Martin, No. 6837 W. A. Starns, No. 7675 E. Hughes, No. 18901 T. Milford, No. 7206 V. Soden, No. 5872 T. Carleton, No. 18680 T. Murphy, No. 7666 W. Holme, No. 7729 F. Hobbs, No. 7656 F. G. Jordan, No. 7571 J. Garland, No. 7008 J. J. Cahill, No. 3817 P. Craven, No. 11324 A. D. Cousins, No. 10913 W. E. Court, No. 1702 A. E. Ranson, No. 14902 H. Mather, No. 20314 E. Sheen, No. 3956 G. Frost, No. 4022 M. Shea, No. 6708 H. M. Williams, No. 1557 J. Newman, No. 7660 J. H. Fisher, No. 1351 E. G. V. Rannow, No. 4440 J. Coulter, No. 6372 T. Jordan, No. 5323 R. Bailey, No. 6966 W. Lewin, 20332 R. T. Davies, No. 4881 H. Gibbons, No. 10352 J. Hudson, No. 709 F. J. Wakeman, No. 4064 F. W. Dent, No. 2547 J. W. Ward, No. 2906 A. Clarke, No. 7236 S. W. Harvey, No. 6977 C. E. Loxton, No. 5980 R. S. St. Clair, No. 7225 H. T. Monk, No. 4345 E. J. Eate, No. 7472 A. Rowntree, No. 7045 L. Jones, No. 2387 W. Francis, No. 2664 J. C. Harper, No. 7689 A. E. Baylis, No. 18896 D. Hunter, No. 35 P. Gerathy, No. 19281 F. T. Northcott, No. 9915 D. B. Mitchell, No. 10040 A. G. Minchington, No. 10134 S. Sayer, No. 10034 N. Callander, No. 5957 G. Raymond, No. 10107 H. G. Turland,

No. 10099 F. Murray, No. 10146 T. J. Flanagan, No. 10111 R. M. Thomas, No. 2716 R. Halley, No. 9912 F. Thompson, No. 4504 A. S. Dixon, No. 20860 J. C. Field, No. 20632 A. H. Gibbon, No. 20616 A. Holway, No. 20082 J. Miller, No. 20234 A. Morgan, No. 20531 W. Morgan, No. 7143 A. C. Pollen, 16040 N. J. Hammond, No. 5379 F. Harvey, No. 10028 T. Hodge, No. 2274 H. C. Jones, No. 7812 G. W. Thorp, No. 17667 C. Redley, No. 2411 S. T. W. Langford, No. 6358 E. Collins, No. 5138 D. Ransome, No. 15392 J. Slater, No. 20722 T. J. Dilworth. No. 20730 T. Birch, No. 20535 E. Greathead, No. 20050 J. Eckersley, No. 20793 T. Bradshaw, No. 10155 G. Baker, No. 10120 W. J. Bradfield, No. 20833 W. Jaques, No. 20151 E. Jones, No. 20189 F. Smith, No. 20699 J. Wetton, No. 20439 E. Spedding, No. 23 C. G. Conn, No. 20472 L. Collins, No. 11826 G. Probert, No. 6664 E. H. Turfrey, No. 137 R. Birtwistle, No. 4751 P. Hart, No. 2202 A. Russell, No. 4181 T. Gillespie, No. 967 F. Dinsdale, No. 5898 C. E. Stone, No. 19440 C. J. Phillips, No. 8908 J. Welsh, No. 18401, J. T. Goodall, No. 2125 F. Freed.

These advancements are subject to the conditions laid down in para. 35 Standing Orders for the Royal Army Medical Corps.

Sanitary Orderlies.—The following Private is advanced to the fourth rate of Corps Pay at 6d. as Sanitary Orderly from the date specified :—

No. 5887 Private W. H. Groves, January 21, 1916.

Reposting to Corps.

The undermentioned N.C.O.'s rejoined the Corps on the dates specified :—

No. 11700 Staff-Serjeant M. Stroud, dated September 18, 1915, from Colonial Government; No. 17573 Staff-Serjeant C. Harlen, dated October 13, 1915, from Colonial Government; No. 12053 Staff-Serjeant W. Ross, dated November 11, 1915, from Colonial Government; No. 10831 Serjeant H. W. G. Gregory, dated November 1, 1915, from Territorial Force; No. 11812 Staff-Serjeant W. C. Banks, dated November 2, 1915, from Territorial Force; No. 8417 Staff-Serjeant J. Davis, dated November 2, 1915, from Territorial Force; No. 10087 Staff-Serjeant E. Canterbury, dated November 6, 1915, from Territorial Force; No. 10011 Staff-Serjeant J. H. Taylor, dated November 8, 1915, from Territorial Force; No. 19029 Staff-Serjeant R. E. Harvey, dated November 15, 1915, from Colonial Government; No. 8730 Staff-Serjeant W. C. Audus, dated November 16, 1915, from Territorial Force; No. 7850 Staff-Serjeant J. Carroll, dated October 30, 1915, from Territorial Force; No. 10953 Staff-Serjeant W. H. Way, dated November 7, 1915, from Territorial Force; No. 8137 Staff-Serjeant T. French, dated November 7, 1915, from Territorial Force; No. 8682 Staff-Serjeant G. Read, dated November 7, 1915, from Territorial Force; No. 8510 Staff-Serjeant W. H. Butler, dated November 8, 1915, from Territorial Force; No. 7772 Staff-Serjeant C. Watts, dated November 8, 1915, from Territorial Force; No. 16227 Staff-Serjeant J. Ashworth, dated November 10, 1915, from Territorial Force; No. 10076 Staff-Serjeant W. H. Brown, dated November 11, 1915, from Territorial Force; No. 9467 Staff-Serjeant C. J. Tunn, dated November 18, 1915, from Territorial Force; No. 7151 Staff-Serjeant E. Dyer, dated November 22, 1915, from Territorial Force; No. 12266 Staff-Serjeant H. Parker, dated November 22, 1915, from Territorial Force; No. 18985 Staff-Serjeant S. Shaw, dated November 24, 1915, from Territorial Force; No. 9747 Staff-Serjeant C. Williams, dated November 29, 1915, from Territorial Force; No. 7721 Staff-Serjeant F. Waller, dated December 1, 1915, from Territorial Force; No. 9083 Staff-Serjeant A. G. Bright, dated December 1, 1915, from Territorial Force; No. 17857 Staff-Serjeant A. E. Macklen, dated December 4, 1915, from Egyptian Army; No. 7438 Staff-Serjeant W. Argent, dated December 21, 1915, from Territorial Force; No. 14609 Staff-Serjeant W. P. Oldridge, dated December 28, 1915, from Territorial Force; No. 8903 Staff-Serjeant J. Robson, dated January 4, 1916, from Territorial Force; No. 13194 Staff Serjeant W. F. Avery, dated January 20, 1916, from Territorial Force; No. 9013 Staff-Serjeant J. Buggy, dated December 21, 1915, from Territorial Force; No. 10333 Staff-Serjeant T. Martin, dated December 21, 1915, from Territorial Force.

Amendments—Corps Orders.

(*a*) In Corps Order dated September 18, 1915, under the heading "To be Serjeants": Delete remarks "Special as Clerk" against No. 17820 Corporal H. Peckham. The remarks against No. 5235 Corporal G. H. Botten, should read "Special as Clerk." Add remarks "Special as Drill Instructor" against No. 6954 Corporal W. E. Fallaize.

(*b*) In Corps Order dated September 18, 1915, the Corps number of Private E. L. W. Chubb, appointed to the Nursing Section, should read 2486 and not 2846.

(*c*) In Corps Order dated September 18, 1915, the Corps number of Private A. A. Fisher, advanced to the fourth rate of Corps Pay, should read 20499 and not 20449.

ADVANCEMENT—CORPS PAY CANCELLED.

In Corps Order dated September 18, 1915, the advancement to the fourth rate of Corps Pay as Cook of No. 4759 Private R. A. Peters, is hereby cancelled.

NOTICE.

Operating Room Attendants.

It is notified for general information that there is no objection to the two months' instruction under the Cutler, as required by paragraph 353 Standing Orders, Royal Army Medical Corps, being held in abeyance for the present, and that N.C.O.'s and men who are otherwise eligible under the above quoted paragraph may be permitted to present themselves for examination, as laid down in paragraphs 355 and 356, and if they pass the examination they may be registered as qualified operating room attendants.

NOTICE.

Additional Corps Pay.

War Office authority has been granted for the issue of additional Corps Pay under Article 863 of the Royal Warrant for Pay, on the following scale :—

(i) One trained Laboratory Attendant for each station where a laboratory is actually in use.

(ii) One trained Attendant in Skiagraphy, &c., for each station where there is a complete apparatus actually in use.

(iii) One Operating Room Attendant for each hospital of from 100 to 500 beds where there is an operating theatre, and one additional if the beds exceed 500, or where there are two operating theatres.

Training in Nursing Duties.

It is notified for general information that time spent in performing nursing duties with units of the Expeditionary Forces may be permitted to reckon in computing the three years of training in the case of Non-Commissioned Officers and men enlisted in or transferred to the Corps prior to January 1, 1907, for whom the possession of Army Form C. 344 is not a necessity in order to qualify them for promotion to the rank of Staff-Serjeant, under paragraph 250 (*c*) (2), Standing Orders, Royal Army Medical Corps.

(2) Foils from Army Book 300 or manuscript certificates in lieu should be forwarded to this office in order that the course of training may be verified as laid down in paragraph 314 (2).

Laboratory and Operating Room Attendants.

It is notified for general information that the following modifications in the courses of instruction and examinations have been authorized for the duration of the war.

Laboratory Attendants.—The course of instruction will last six months and may be carried out in any recognized laboratory, including mobile laboratories. The syllabus as laid down in Appendix 5, Standing Orders, Royal Army Medical Corps, should be adhered to as far as possible. The examination at the termination of the course must be conducted by two officers and the result forwarded to the Officers i/c Records.

Operating Room Attendants.—The necessity for the possession of Army Form C. 344 is suspended for the present. Candidates for the course must be first-class orderlies drawing the third rate of Corps pay, and before presenting themselves for examination must have worked for three months in an operating theatre, and have been in subordinate charge of an operating room for a further period of three months. The examination will be conducted as laid down in paragraphs 355 and 356, Standing Orders, Royal Army Medical Corps.

Time already spent under instruction in either of the above capacities before the issue of this notice will be allowed to reckon, but it must be certified in all cases that the candidates have undergone the full period of six months' training, when the proceedings of the Board are transmitted to this office.

Instruction in Sanitary Duties.

It is notified for general information that authority has been obtained for the following modification during the war of the course of instruction in sanitary duties laid down in Appendix 6, Standing Orders, Royal Army Medical Corps. Men who have been actually employed in sanitary duties and sanitary sections and squads for six months will, if recommended and certified by their Officer Commanding as efficient in these duties, be eligible for advancement from fifth to fourth rate of Corps pay whilst they continue to be employed in such duties.

(2) A certificate should be rendered to this office in the form shown below for registration :—

"*I certify that*.. *has been actually employed in Sanitary Duties for six months and is thoroughly efficient in those duties.*"

Officer Commanding.

Sanitary Section or Sanitary Squad.

ROYAL ARMY MEDICAL CORPS FUND.

NOTICE OF THE ANNUAL GENERAL MEETING.

The Annual General Meeting of subscribers to this Fund will be held in the Library of the Royal Army Medical College, Grosvenor Road, S.W., at 2.30 p.m. on Monday, June 12, 1916.

The Director-General will preside.

It is hoped that all officers will freely express their views on any point connected with the Fund. Those officers who may wish for information on any special point are requested to communicate with the Secretary, so that the necessary information may be furnished in response to any question asked.

F. W. H. DAVIE-HARRIS,
Lieutenant-Colonel,
Secretary.

124, *Victoria Street, S.W.*

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

NOTICE OF THE ANNUAL GENERAL MEETING.

The Annual General Meeting of subscribers to this Society will be held in the Library of the Royal Army Medical College, S.W., at 3 p.m. on Monday, June 12, 1916.

The Director-General will preside.

It is hoped that all officers will freely express their views on any point connected with the Society. Those officers who may wish for information on any special point are requested to communicate with the Secretary so that the necessary information may be furnished in response to any question asked.

F. W. H. DAVIE-HARRIS,
Lieutenant-Colonel,
Secretary.

124, *Victoria Street, S.W.*

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

As inquiries are made from time to time as to whether the above Society is still open to new members it may be well to state again that on the outbreak of War the Committee, as empowered by Rule V (amended for this purpose in June, 1911), decided, on the advice of the Actuary, that for the time being no new members should be admitted to the Society except at an extra charge of fifty guineas per annum, in addition to the normal annual subscription according to scale. Further that in view of the possible large increase of the Corps, admission be limited to officers and probationers on the strength of the Corps at the outbreak of war; the Committee reserving to itself power to close the Society, temporarily, to all new members, should this at any time seem desirable.

The Actuary has also recommended that, when peace is declared, the Committee should consider the question of the refund of a proportion of the extra annual premium for risk unincurred.

The Secretary will be glad to give any further information in his power.

3, *Homefield Road,* J. T. Clapham, *Captain,*
Wimbledon, S. W. *Secretary.*

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

A meeting of the Committee of this Fund was held at the Royal Army Medical College on January 10, 1916.

Present:

Lieutenant-Colonel F. S. Irvine, representing Aldershot, in the Chair.
Major G. B. Russell, representing Netley.
Major G. A. D. Harvey, representing Curragh.
Major G. R. Painton, representing Portsmouth (Cosham).
Captain H. G. Gibson, representing London.
Captain F. C. Cowtan, representing Woolwich.

Abstract of the Proceedings.

The Balance Sheet and Accounts of the year ending February 28, 1915, were adopted.

The Hon. Secretary reported that on the closing of the Royal Army Medical Corps Mess at Robert's Heights, Pretoria, in August, 1914, the members had transferred their cash balance of £138 11s. 2d. to the Central Fund, and had also placed at the disposal of its Committee various articles of mess property, plate, etc. The Hon. Secretary having stated that he had thanked the donors at the time, the Committee desired to record on the Minutes their appreciation of the spirit which had prompted this generous gift.

Applications for help from various Messes were considered.

The Hon. Secretary of the London Mess reported that the net loss of that mess from August, 1914, till the end of December, 1915, had been £531 7s. 11d., by far the greater part of which (£497 2s. 8d.) had been on account of maintenance.

The mess had £1,076 in Home and New South Wales stocks, which obviously could not be sold under present conditions. The cash balance at the bank was very small. Although a great many officers, both Regulars and Temporary ranks, Royal Army Medical Corps, are using the mess for short periods, mess subscriptions and maintenance cannot be charged against them, and a large amount of revenue, hitherto accruing to the mess, is lost. At the present time there are fourteen actual subscribing members of the mess, as against an average of 106 in normal times.

The Committee, after carefully considering the matter, were satisfied that every effort is being made to keep expenses as low as possible and that help is urgently needed to provide for the proper upkeep of the mess. They therefore resolved that a grant of £250 be made for this purposes. They also were of opinion that under the very special circumstances now existing steps might be taken to approach the Government on this matter.

A letter was read from the Hon. Secretary, Lucknow Mess, stating that it was in serious financial difficulties due to the cessation of Government grant owing to the

decrease in membership. Also that in the heavy rains part of the mess house had collapsed and much loss had been thereby caused. A grant of £50 was made. A similar grant was made to the Peshawar Mess which was in serious difficulties owing to war conditions. The Hon. Secretary reported that in January, 1915, the Bangalore Mess was in danger of being closed, the Government grant having been withdrawn, and the mess funds being liable for rent till 1917. A grant of £100 had been asked for to enable the mess to be kept open. Owing to the impossibility of assembling a meeting of the Committee at that time the immediate payment of a sum of £50 had been sanctioned by the Chairman as an emergency measure, with the possible payment of another £50 if required. This action was confirmed by the Committee.

The Netley Mess having asked for help to finish the additional temporary officers' quarters just built there, a loan of £200 was offered. (It was not considered advisable by the Netley Mess Committee to accept this.)

Applications for help towards outfit by the Codford Mess, and for a grant to purchase a billiard table by the Twiseldon Camp Mess were not approved. The Committee considered that these were war messes and that the sphere of the central fund is restricted to those permanently established.

The Committee authorized the investment of £400, now on deposit at the bank, in 5 per cent. Exchequer Bonds, to be held by Messrs. Holt and Co., at the order of the Chairman and Hon. Secretary for the time being; together with the similar investment of any further sum which may from time to time be considered advisable by the Chairman.

In the absence of a General Meeting, Mr. E. T. Gann was appointed auditor for the year 1915-16.

In order to facilitate the business of the Committee during the War a sub-Committee, with a quorum of three, was given full powers to transact any urgent business should it not be practicable to assemble the General Committee.

3, *Homefield Road,*
Wimbledon, S.W.

J. T. CLAPHAM, *Captain,*
Hon. Secretary.

THE CENTRAL DEPOT, SURGICAL BRANCH OF QUEEN MARY'S NEEDLEWORK GUILD.

2, CAVENDISH SQUARE, W.

OFFICERS of the Royal Army Medical Corps are cordially invited by the Council to visit the depot on April 5, when the workrooms will be open for inspection.

Large quantities of surgical dressings and other hospital supplies are despatched daily. All genuine appeals are granted free.

OBITUARY

THE LATE COLONEL E. O. WIGHT, A.D.M.S., —— DIVISION.

AN APPRECIATION.

By COLONEL H. N. THOMPSON, D.S.O.

STRANGELY enough, I had never met Colonel Wight until his Division joined the — Corps in July last. His striking personality soon became apparent at our weekly conference of medical officers. He was an absolutely fearless man, full of energy and zeal, spending a great part of his time in the fire trenches and aid posts instructing his regimental officers; he encouraged all ranks by his cheery presence. He was a fine horseman, and did nearly all his work in the divisional area mounted. Despising roads and motor-cars, he would make his point across country, and frequently used up two horses in a day's work. In the matter of administration he was almost a pioneer; devoted heart and soul to his work and to the interests of the soldiers in his charge, he was always devising and organizing things for their comfort.

As a colleague he was most loyal; ready with advice and suggestions, which, coming from a man who had been everywhere and seen everything with his own eyes, were always full of practical wisdom and knowledge.

Since his death, tales of his prowess in the various fields of sport come in from all sides. In the hunting field at home and the plains and jungles of India and Burmah—

alike with spear, gun and rifle—he excelled. One incident, of how he, with a single companion, when a Cadet at Netley, sailed an open boat across to Cherbourg and back, is typical of the innate courage of the man. On three different occasions he was decorated or distinguished by the Royal Humane Society for saving lives.

To his own officers and men he was the ideal chief, and soon drew from them an affectionate devotion and respect. He always spoke of them with pride, and by his personal qualities and bright example was able to draw the very best out of all of them.

On the morning of a recent gas attack he, with three others, was killed by the bursting of a shell just as they were leaving a collecting station, after having dispatched two ambulance cars loaded with wounded.

Colonel Wight belonged to the best type of officer which the Royal Army Medical Corps produces—a hard and conscientious worker, with whom duty was before all; a thorough all-round sportsman, and a gentleman to his finger-tips, it was inconceivable that anything sordid or mean could touch him.

I think he died the death he would have preferred to die—the death on the field of honour, the hero's death, the death most befitting such a very gallant officer and gentleman.

BIRTH.

HELM.—On February 22, at 21, Brondesbury Park, London, N.W., the wife of Captain Cyril Helm, R.A.M.C., of a daughter.

MARRIAGE.

DAWSON—BISSET.—At Aberdeen, on February 19, 1916, Captain George Forbes Dawson, R.A.M.C., to Catharine, second daughter of the late William Bisset and Mrs. Bisset, 38, Albyn Place, Aberdeen.

DEATHS.

O'BRIEN.—Lieutenant-Colonel Thomas Michael O'Brien, Army Medical Service, retired) died at Marypole Villa, Pennsylvania, Exeter, on January 20, 1916.

LEADER.—Lieutenant-Colonel Nicholas Leader, R.A.M.C. (retired), died at Craven House, Brentwood, Essex, on January 21, 1916.

SANDERSON.—Lieutenant-Colonel Arthur Sanderson, R.A.M.C. (retired), died at Upper King's Cliffe, St. Heliers, Jersey, C.I., January 23, 1916.

ROBINSON.—Lieutenant-Colonel Robert Henry Robinson, F.R.C.S.I. (retired), died at Guernsey, on January 25, 1916.

BELEMORE.—Honorary Brigade-Surgeon, Surgeon Lieutenant-Colonel Alfred John Belemore, died at 317, Ditchling Road, Brighton, on February 4, 1916.

CROFTS.—Major Richard Crofts, D.S.O., R.A.M.C. (retired), died at Cork on February 16, 1916.

O'LEARY.—Brigade-Surgeon Honorary Dep. Surgeon-General Eugene Francis O'Leary, M.D., Army Medical Service (retired), died at Audley, Sidmouth, on February 20, 1916.

BARRINGTON.—Surgeon-Major Henry Ernest Walter Barrington, M.B., F.R.C.S.I., died at Craig House, Morningside, Edinburgh, on March 2, 1916.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Captain H. W. Bayly, R.A.M.C.(T.), 2/1st South Western Mounted Brigade Field Ambulance, late Civil Surgeon General Plumer's Force, South Africa, wishes to exchange with a M.O. of a British Cavalry or Yeomanry Regiment in France. Address, Maresfield Park Camp, Uckfield, Sussex.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates :—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of EXCERPTS *	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2	4 3	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 1s. 8d. net; binding, 1s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

All Applications for Advertisements to be made to—

G. STREET & CO., Ltd., 8, Serle Street, London, W.C.

The back outside cover is not available for advertisements.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Colonel C. A. Ballance, Colonel R. H. Firth, Lieutenant-Colonel G. J. Stoney Archer, Lieutenant-Colonel Gordon Holmes, Lieutenant-Colonel C. S. Myers, Lieutenant-Colonel G. N. Stephen, Lieutenant-Colonel C. Gordon Watson, Major Sir John Collie, Major R. H. Lucy, Major P. J. Marett, Major E. K. Martin, Captain C. G. Alderson, Captain A. W. Bourne, Captain M. Culpin, Captain R. V. Dolbey, Captain H. W. Drew, Captain H. H. Hepburn, Captain J. L. Joyce, Captain Colin Mackenzie, Captain H. J. McGrigor, Captain J. W. McNee, Captain J. Morley, Captain G. T. Mullally, Captain F. Battinson Smith, Captain S. Smith, Captain A. A. Straton, Captain A. C. H. Suhr, Captain T. Warrington, Lieutenant W. Campbell, Lieutenant S. C. Dyke, Lieutenant D. N. Livingstone, Sergeant H. J. Davey.

The following publications have been received:—

British: Medical Press and Circular, The Royal Engineers' Journal, The Society of Tropical Medicine and Hygiene, St. Bartholomew's Hospital Journal, The Journal of State Medicine, Red Cross and Ambulance News, Transactions of the Society of Tropical Medicine and Hygiene, The Medical Journal of Australia, The Lancet, The Hospital, Public Health, The St. Thomas's Hospital Gazette, Guy's Hospital Gazette, The Quarterly Journal of Medicine, Yellow Fever Commission (West Africa), The Journal of Tropical Medicine and Hygiene, The Medical Journal of South Africa, Tropical Diseases Bureau, Bulletin of Entomological Research, Proceedings of the Royal Society of Medicine, The Middlesex Hospital Journal, The Medical Review, Commonwealth of Australia, Philosophical Transactions of the Royal Society of London.

Foreign: The Military Surgeon, Archives de Médecine et de Pharmacie militaires, Revista de Sanidád Militar, Bulletin de l'Institut Pasteur, Bulletin de la Société de Pathologie Exotique, United States Department of Agriculture, Tidskrift I Militär Hälsovärd, Office Internationale d'Hygiène Publique, The International Military Digest, Le Caducée, The Journal of Infectious Diseases, Russian Naval Medical Journal, United States Public Health Service, Giornale di Medicina Militare, Bulletin of the Johns Hopkins Hospital, Proceedings of the Medical Association of the Isthmian Canal Zone, The Philippine Journal of Science, The Research Institute of the National Dental Institution, United States.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

APRIL, 1916.

EXTRACT FROM THE "LONDON GAZETTE," MARCH 10-11, 1916.

War Office,
March 11, 1916.

With reference to the announcement of the award of Distinguished Conduct Medals in the Honours Supplement of the *London Gazette*, dated January 14, 1916, the following are the acts of gallantry for which the decorations have been awarded.

No. 372 Serjeant C. Abnett, 1st Home Counties Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry. He has worked untiringly while in charge of stretcher-bearers and at the dressing-station, and his bravery and devotion to duty under heavy fire were most marked.

No. 2135 Corporal E. Allen, 26th Field Ambulance, Royal Army Medical Corps (Territorial Force).

For great bravery and resource. He voluntarily remained single-handed for twenty-four hours under heavy shell fire, using with great skill the means at his disposal, thus enabling many men who had collapsed to gain the dressing-stations on foot.

No. 47768 Private A. Barton, Royal Army Medical Corps (recently transferred to Royal Engineers).

For conspicuous good work and devotion to duty. Although wounded by a bullet through the thigh he continued to superintend his front throughout the whole period of the attack.

No. 1502 Private F. Bennison, Royal Army Medical Corps.

For gallant conduct and devotion in volunteering for isolation with cerebrospinal fever patients and nursing them devotedly for many weeks.

No. 176 Serjeant G. Bland, 1/2nd West Riding Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry when in charge of stretcher-bearers. His bravery and devotion to duty were at all times most marked.

No. 1861 Private J. G. Bruce, 1st Reserve Highland Field Ambulance, Royal Army Medical Corps (Territorial Force) (formerly 2/1st).

For conspicuous gallantry when in charge of an ambulance wagon and two horses. One horse was killed and the other, which he was riding, wounded, he himself being struck by the fragment of a shell. The ambulance was full of wounded at the time. Private Bruce unhooked his wounded horse, rode it, returned with a fresh pair, and continued his duties under shell fire until all the wounded had been brought in.

No. 20413 Corporal D. Burch (Special Reserve), Royal Army Medical Corps.

For conspicuous gallantry. Corporal Burch always exhibited great bravery and resource, and was a fine example to all ranks with him, until he was severely wounded.

No. 32712 Private E. G. Butcher, Royal Army Medical Corps.

For conspicuous gallantry, when he went out, under very heavy rifle and shell fire, to assist wounded and give help to the regimental stretcher bearers. He continued his good work all day, and until severely wounded on the following day.

M2/074942 Driver G. E. Caley, Army Service Corps (attached Royal Army Medical Corps).

For conspicuous gallantry when he assisted in taking an ambulance car to the first line of the old enemy trenches where another car was in difficulties. He assisted to load the wounded on to his own car, and then towed the other car back to the dressing-station, all the time under fire.

No. 1147 Corporal H. Carley, 1st Yorkshire Mounted Brigade Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry in volunteering to accompany an officer in rescuing a wounded officer and man. His devotion to duty was very marked.

No. 2337 Private D. W. Darling, 2nd London Sanitary Company, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry. While in the trenches Private Darling displayed great bravery and devotion under heavy shell fire in collecting the wounded for ten hours.

No. 35664 Serjeant R. Davis, Royal Army Medical Corps.

For conspicuous gallantry during attacks and counter-attacks, in charge of stretcher-bearers. Later, calling for volunteers, he cleared away the wounded.

No. 677 Staff-Serjeant E. Dymond, Welsh Border Mounted Brigade Field Ambulance, Royal Army Medical Corps (Territorial Force) (attached 7th Cavalry Brigade Field Ambulance).

For conspicuous gallantry, when he was instrumental in saving many lives under heavy fire. On another occasion, while a town was being shelled, he continued to carry wounded until all had been rescued.

No. 30902 Serjeant E. Eyre, Royal Army Medical Corps.

For conspicuous gallantry in attending to wounded. Although suffering from shock he insisted in remaining on duty. He was ordered back, but, although suffering, he returned to work early next morning.

No. T/22199 Acting Serjeant F. Freathy, Army Service Corps (attached Royal Army Medical Corps).

For conspicuous gallantry and devotion throughout the campaign whilst superintending the collection of wounded in wagons, frequently under heavy fire.

No. 34110 Private W. Gant, Royal Army Medical Corps.

For conspicuous gallantry in going out to the front and bringing in wounded men, under heavy fire.

No. 732 Corporal J. W. Gray, 1st Northumbrian Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry when he left the dressing station and advanced over open country, under heavy shell fire, carrying a medical pannier, reaching the trenches and rendering first-aid to many wounded. Later he took charge of a dressing station and assisted to remove many wounded men to hospital. Part of the station was destroyed by shell fire during that time.

No. M2/080226 Private G. Grover, Army Service Corps (attached Royal Army Medical Corps).

For conspicuous gallantry. He assisted in taking an ambulance car to the first line of old enemy trenches, where another car was in difficulties. He transferred the wounded to his own car, then towed the other back to the dressing-station, all the while under fire.

No. 4093 Private J. Grundy, Royal Army Medical Corps.

For conspicuous gallantry; he repeatedly led stretcher parties under very heavy shell fire, to collect and carry in wounded.

No. 51088 Private G. T. Halls, Royal Army Medical Corps.

For conspicuous gallantry; he went forward to the support trenches, which were being heavily shelled, to attend to wounded, and returned to bring back assistance. He displayed great bravery and devotion.

No. 3311 Private W. Hanson, Royal Army Medical Corps.

For conspicuous gallantry on many occasions under heavy fire, particularly on one occasion in attending to wounded.

No. 113 Serjeant S. M. Harrie, 3rd London Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry. He displayed great bravery and initiative in taking his stretcher-bearers to wounded, improvising means of transport, and carrying away thirty badly wounded men under heavy fire.

No. 12433 Private C. A. T. Hughes, Royal Army Medical Corps.

For consistent conspicuous gallantry and devotion. On one occasion all the other stretcher-bearers of the assaulting company were either killed or wounded, and Private Hughes practically dressed all the wounded of the battalion in the captured trenches, under very heavy fire, for about twenty-four hours. His energy and devotion were the means of saving many lives.

No. 46084 Lance-Corporal A. E. Jeffers, Royal Army Medical Corps.

For conspicuous gallantry; for four consecutive days and nights he attended to and brought in wounded men, under heavy fire.

No. 727 Serjeant W. F. Jenkins, 2nd Home Counties Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry at the dressing-station where he attended to and removed wounded under heavy shell fire.

No. 1714 Corporal L. Kennedy, 1st Northumbrian Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry. On numerous occasions Corporal Kennedy exhibited the greatest bravery and resource in tending and bringing in wounded under fire. No danger was too great for him, and he invariably displayed the highest devotion in the performance of his duties.

No. 10363 Private G. Kilpack, Royal Army Medical Corps.

For conspicuous gallantry. On three separate occasions he went out in front of the trenches occupied by the 2nd Munster Fusiliers, under heavy shell and machine-gun fire, and dressed wounded men.

No. 17767 Staff-Serjeant H. G. Kimber, Royal Army Medical Corps.

For conspicuous gallantry; by his energy and promptness he was able to transfer helpless wounded to cellars during the heavy shelling of the field ambulances. His bravery and devotion undoubtedly saved many lives.

No. 17898 Private W. Knagg, Royal Army Medical Corps.

For conspicuous gallantry; he performed many acts of bravery in dressing and carrying in wounded men, under fire.

No. 19863 Staff-Serjeant W. H. Mattison, Royal Army Medical Corps.

For conspicuous gallantry and devotion through the campaign when in a field unit. Later he has shown remarkable powers as a register clerk in the office of the D.G.M.S.

No. 365 Private F. McGarry, Royal Army Medical Corps.

For conspicuous gallantry when he collected and attended wounded under continuous rifle and shell fire.

No. 45 Staff-Serjeant T. J. Moffatt, Royal Army Medical Corps.

For conspicuous gallantry since mobilization when attached to the 1st Bedfordshire Regiment. He displayed great bravery and coolness in attending to the wounded under fire.

No. 6017 Corporal H. Moody, Royal Army Medical Corps.

For conspicuous bravery in collecting and bringing in, on his own initiative, officers and men of other regiments, wounded. On another occasion he brought in, without orders, two wounded officers to a dressing-station, under heavy fire.

No. 38070 Lance-Corporal J. R. Morrison, Royal Army Medical Corps.

For conspicuous gallantry in charge of a stretcher-bearer party bringing in wounded under very heavy fire. He kept his men together, and did invaluable work for forty-eight consecutive hours, never sparing himself at any time under trying circumstances.

No. 19807 Private E. J. Murphy, Royal Army Medical Corps.

For conspicuous gallantry on many occasions in attending to wounded men during operations.

No. 1993 Serjeant E. G. Passingham, Royal Army Medical Corps.

For conspicuous gallantry in rallying stretcher-bearers and carrying in wounded under heavy fire.

No. 14082 Staff-Serjeant G. Prince, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty whilst attached to a small force which was surrounded by the enemy. He attended to our casualties with absolute indifference to his own safety, remaining exposed to heavy fire for two hours.

No. 9027 Private P. T. Pronger, Royal Army Medical Corps.

For conspicuous gallantry in collecting wounded under very heavy shell and rifle fire.

No. 2093 Acting Serjeant E. Roberts, 2nd London Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry and good work on all occasions, frequently under circumstances of very great danger and difficulty. He has always exhibited great ability and devotion in the performance of his duties.

No. 4919 Private T. Roberts, Royal Army Medical Corps.

For conspicuous gallantry when he assisted to get in many wounded under heavy fire. He has lately saved a man from drowning.

No. 2275 Corporal W. C. Ross, Royal Army Medical Corps.

For conspicuous gallantry when he was in charge of a bearer sub-division, working a distance of about 1,000 yards, which was heavily shelled throughout the operations. He exhibited great bravery and ability in the performance of his duties, and was always ready to undertake any work, however dangerous.

No. 754 Serjeant H. Russell, Royal Army Medical Corps.

For conspicuous gallantry during the period he kept open two advanced offices, both of which were heavily shelled and the offices demolished. In spite of this, he kept up constant communication with the D.A.D.M.S., and through him orders were conveyed with promptness aud accuracy.

No. 10711 Serjeant-Major F. W. Sharpe, Royal Army Medical Corps.

For conspicuous gallantry and devotion in the performance of his duties, on many occasions under heavy fire.

No. 739 Serjeant W. Sharpe, 2nd Home Counties Field Ambulance, Royal Army Medical Corps (Territorial Force).

For conspicuous gallantry and continuous good work with stretcher-bearers, on numerous occasions, in the collection and removal of wounded from aid-posts, and especially on a night when four of his party were killed and twelve wounded.

No. 40218 Lance-Corporal E. Shepherd, Royal Army Medical Corps.

For conspicuous gallantry. Lance-Corporal Shepherd showed great bravery and devotion in removing wounded, who were in exposed positions, and, although slightly wounded himself, continued his work until all the wounded were placed in safety.

No. 1269 Lance-Corporal G. Snowden, 1/2nd Northumbrian Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry. When a village was being demolished, Lance-Corporal Snowden with the greatest bravery carried on his duty as bearer under continuous and heavy shell fire, when all with him, eight in number, had been killed or wounded. It was largely owing to his devotion to duty that the wounded in the village were successfully withdrawn.

No. 478 Private R. Symes, Royal Army Medical Corps.

For conspicuous gallantry. During four consecutive days and nights he repeatedly went out, under heavy fire, and brought in wounded men.

No. 440 Private F. Taylor, Royal Army Medical Corps.

For conspicuous gallantry when he led a stretcher-bearer party under heavy shell fire to render aid and bring back men to the dressing-station. The party proceeded without any orders from an officer, and great bravery was shown throughout.

No. 9467 Staff-Serjeant C. J. Tunn, Royal Army Medical Corps.

For conspicuous gallantry and devotion. By his bravery and example he was able to keep the men with him at work, under heavy fire, and arranged and personally conducted the wounded to places of safety.

No. 1911 Corporal N. W. J. Turnbull, Royal Army Medical Corps.

For gallantry and devotion to duty in attending to the wounded whilst exposed to heavy fire.

No. 515 Lance-Serjeant J. W. Wagg, 1st North Midland Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry; he showed great bravery and ability in the performance of his work under most critical conditions, and exposed to heavy shell and rifle fire.

No. 20747 Private H. Wallis, 1st Home Counties Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry; he brought a motor ambulance into position for receiving wounded, and, in spite of heavy shelling all round, continued, with great bravery, to perform his duties until all the wounded had been removed.

No. 5367 Private A. J. Weston, Royal Army Medical Corps.

For conspicuous gallantry in attending to wounded after his medical officer had

been killed early in the action. Later, when his medical bag had been destroyed, he went back to the dressing-station, obtained medical appliances, and returned to attend the wounded in the trenches under heavy shell fire.

No. 41 Corporal R. Witham, 1st Lowland Field Ambulance, Royal Army Medical Corps, Territorial Force (attached 1/6th Battalion, Scottish Rifles, Territorial Force).

For conspicuous gallantry; for more than twelve hours he exhibited great bravery and devotion in assisting the medical officer to attend to wounded, under very heavy shell fire, enabling over 200 cases to be taken from the trenches.

No. 20852 Private H. Wilkinson, Royal Army Medical Corps.

For conspicuous gallantry; with great bravery and devotion he attended to and brought in wounded men.

With reference to the awards of the Distinguished Conduct Medal announced in the *London Gazette* of the 2nd ultimo, the following are the acts of gallantry for which the decorations were granted:—

No. 317 Corporal T. Fearing, 1/3rd East Lancashire Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry on August 7 and 8, 1915, at Gallipoli, in charge of stretcher-bearers. During the operations he was continually on duty, and it was due to his courage, skill, and untiring efforts that the wounded were successfully dealt with.

No. 33542 Corporal S. A. Fitch, 30th Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty at Suvla Bay, on August 23, 1915, when he went out under heavy fire to collect the wounded.

No. 32611 Acting Serjeant G. Hughes, 30th Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty at Suvla Bay on August 23, 1915, when he went out under heavy fire to collect the wounded.

No. 922 Private (Acting Lance-Corporal) A. B. Jones, 87th Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry on August 22, 1915, at Suvla Bay, when he went out alone, under heavy fire, to tend and dress wounded men, remaining with them until they could be brought in.

No. 1782 Lance-Corporal H. F. Phillips, 1/3rd Welsh Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry on August 14, 1915, at Suvla, when he tended and dressed the wounded under heavy fire.

No. 410 Private A. Poole, 1/1st East Lancashire Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry on August 7 and 8, 1915, at Gallipoli, as a stretcher-bearer, when his courage and devotion to duty were most marked.

No. 2000 Corporal W. Scott, 88th Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry on August 4, 1915, near Krithia, Cape Helles, when, although severely wounded himself, he dressed two other wounded men before thinking of his own wounds. His courage and devotion throughout the campaign have been most marked.

Whitehall,
March 14, 1916.

The King has been pleased to give and grant unto the undermentioned gentleman His Majesty's Royal licence and authority to wear the Decoration which has been conferred upon him by His Highness the Sultan of Egypt in recognition of valuable services rendered by him.

FOURTH CLASS OF THE ORDER OF THE NILE.

Captain Arthur Gordon Cummins, M.B., Royal Army Medical Corps.

March 14-15, 1916.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-commissioned officers and man for acts of gallantry and devotion in the field:—

No. 1 Serjeant W. E. Holdsworth, 1/2nd West Riding Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty when, during the whole day, he assisted in the removal of the wounded under very heavy shell fire. He has invariably shown great resource and total disregard of danger.

No. 180 Private G. H. Needham, 1/3rd West Riding Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty as a stretcher-bearer, when he worked without a break for twenty hours, removing the wounded under continuous shell fire. His endurance was remarkable, and he set a very fine example.

No. 476 Corporal W. Oliver, 1/3rd West Riding Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and determination in asisting the medical officer for twenty hours without a break in tending the wounded over an area which was continually being shelled.

War Office,
March 30, 1916.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned officer to be a Companion of the Distinguished Service Order, in recognition of his gallantry and devotion to duty in the field :—

Quartermaster and Honorary Lieutenant Edward Lyall, 2nd Northumbrian Field Ambulance, Royal Army Medical Corps, Territorial Force (attached 185th Tunnelling Company, Royal Engineers).

For conspicuous gallantry and devotion to duty. When a large camouflet was blown in by the enemy he hurried through a flooded gallery in the dark, and under heavy fire went for proto apparatus. Finding all the proto apparatus already in use, he hurried on and, although in an exhausted state, descended a shaft without any apparatus, assisted in the rescue of an officer, and then went farther, rendered aid to two men, and made a most gallant effort to save two officers.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned officers, in recognition of their gallantry and devotion to duty in the field :—

Captain Bernard Grellier, Royal Army Medical Corps, Special Reserve (attached 10th Battalion, Royal Welsh Fusiliers).

For conspicuous gallantry and devotion to duty during operations, when tending the wounded under heavy shell fire. He helped to dig out wounded men who were buried.

Temporary Captain Leonard Douglas Saunders, Royal Army Medical Corps (attached 10th Battalion, The Nottinghamshire and Derbyshire Regiment).

For conspicuous gallantry and devotion to duty. He tended the wounded under heavy fire, and finally evacuated them all with great skill and care. His clothing was torn by fragments of shell, and he was at work for forty-eight hours without a rest. This is the third time he has displayed great coolness and devotion to duty.

Temporary Captain Harry Vere White, M.D., Royal Army Medical Corps (attached 7th Battalion, The Lincolnsnire Regiment).

For conspicuous gallantry and devotion to duty during operations when tending the wounded. His dressing-station was repeatedly hit by shells, and he himself was severely knocked about several times, but for thirty-six hours he stuck to his work.

Temporary Lieutenant Reginald Peter Nutcombe Brickland Bluett, Royal Army Medical Corps (attached 8th Battalion, the Durham Light Infantry, Territorial Force).

For conspicuous gallantry. He tended the wounded under heavy shell fire, and was continuously at work for twenty hours. Through his exertions they were removed to a place of safety, although the aid-post was unapproachable owing to the enemy's shell fire.

Temporary Lieutenant John Alexander Harper, M.B., 52nd Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry when leading stretcher-bearers during operations. On one occasion when three of his bearers were wounded he went alone, under heavy shell fire, to the aid-post.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-Commissioned Officers, and men for acts of gallantry and devotion to duty in the field :—

No. 1523 Corporal (Acting Serjeant) J. W. Cherry, 1/3rd Northumbrian Field Ambulance, Royal Army Medical Corps, Territorial Force.

For conspicuous gallantry and devotion to duty in tending and removing the wounded under heavy shell fire to the dressing-station over a mile away. He set a fine example to the stretcher-bearers.

No. 42427 Serjeant W. J. Currie, 59th Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry. Serjeant Currie and Private Fitton succeeded in rescuing from a farm, which was being heavily shelled, seven wounded men, after one man had been killed and another wounded in the attempt.

No. 38359 Private J. J. Fitton, 59th Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry. Serjeant Currie and Private Fitton succeeded in rescuing from a farm, which was being heavily shelled, seven wounded men, after one man had been killed and another wounded in the attempt.

No. 7830 Private R. G. Found, Royal Army Medical Corps (attached 1st Battalion, Liverpool Regiment).

For conspicuous gallantry. When a trench mortar bomb landed in a thickly manned portion of our trench, he rushed up and pinched the fuze before the other men had time to get into safety. He then poured water on the fuze and flung the bomb over the parapet.

No. 40745 Corporal D. H. Molyneux, 53rd Field Ambulance, Royal Army Medical Corps.

For conspicuous gallantry during operations in repeatedly leading stretcher-squads through heavy shell fire.

C.M.T. /3098 Private M. Sheriff, Army Service Corps (attached 53rd Field Ambulance, Royal Army Medical Corps).

For conspicuous gallantry. Although himself injured by a bursting shell, he stopped his ambulance, picked up other men who had been wounded, and brought them in. When his wound was dressed he continued driving.

The President of the French Republic has bestowed the decoration of the Legion of Honour, with the approval of His Majesty the King, on the undermentioned Officer in recognition of his distinguished service during the campaign :—

GRAND OFFICIER.

Surgeon-General Sir Arthur Thomas Sloggett, K.C.B., C.M.G., K.H.S. (Substituted for "Croix de Commandeur," the award of which was announced in *London Gazette*, dated November 8, 1915).

The President of the French Republic has bestowed the decoration "Croix de Guerre" on the undermentioned Officers in recognition of their distinguished service during the campaign :—

Lieutenant-Colonel James Mill, M.B., Royal Army Medical Corps, Territorial Force.

Captain John Arthur Cullum, Canadian Army Medical Corps (attached 28th Canadian Infantry Battalion).

Captain Eric Dalrymple Gairdner, M.B., Royal Army Medical Corps, Territorial Force.

Captain George Herbert Rae Gibson, Canadian Army Medical Corps (attached Headquarters 1st Canadian Division).

There are no restrictions as to the occasions on which any of these decorations may be worn.

ARMY MEDICAL SERVICE.

Surgeon-General James G. MacNeece, C.B., is retained on the Active List under the provisions of Articles 120 and 522, Royal Warrant for Pay and Promotion, and to be supernumerary, dated February 27, 1916.

Lieutenant-Colonel John P. Silver, M.B., to be temporary Colonel whilst Assistant Director of Medical Services of a Division, dated February 6, 1916.

Lieutenant-Colonel James Young, M.D., 3rd South Midland Field Ambulance, to be Assistant Director of Medical Services, South Midland Division, with the temporary rank of Colonel, *vice* Colonel William H. Bull, F.R.C.S.Edin., dated February 18, 1916.

Colonel William Henry Bull, F.R.C.S.Edin., from Assistant Director of Medical Services, to be Colonel, dated February 18, 1916.

Colonel Sinclair Westcott, C.B., C.M.G., is retained on the Active List under the provisions of Articles 120 and 522, Royal Warrant for Pay and Promotion, and to be supernumerary, dated February 23, 1916.

Colonel Charles E. Nichol, C.M.G., D.S.O., M.B., on completion of four years' service in his rank, is retained on the Active List, under the provisions of Article 120, Royal Warrant for Pay and Promotion, and to be supernumerary, dated March 9, 1916.

Temporary Lieutenant-Colonel William H. Willcox, M.D., F.R.C.P., Royal Army Medical Corps, to be temporary Colonel, dated March 15, 1916.

Temporary Colonel the Honourable Sir Arthur Lawley, G.C.S.I., G.C.I.E., K.C.M.G., relinquishes his commission on ceasing to hold the appointment of Commissioner, British Red Cross Society, dated March 29, 1916.

ROYAL ARMY MEDICAL CORPS.

Lieutenant-Colonel George St. C. Thom, M.B., Royal Army Medical Corps, to be a Deputy Assistant Director-General *vice* Lieutenant-Colonel W. R. Blackwell, dated April 1, 1916.

Lieutenant-Colonel Robert Balfour Graham, F.R.C.S.Edin., late Royal Army Medical Corps, Territorial Force, to be temporary Lieutenant-Colonel, dated November 11, 1915.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst in command of a Casualty Clearing Station:—

Dated September 23, 1915.—John H. Brunskill, M.B.

Dated October 3, 1915.—Arthur R. C. Parsons. (Substituted for the notification which appeared in the *Gazette* of January 26, 1916.)

Dated October 9, 1915.—Robert H. L. Cordner.

Dated December 17, 1915.—Harry T. Wilson.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst commanding Field Ambulances:—

Dated January 23, 1916.—Major (temporary Lieutenant-Colonel) Charles H. Straton to retain his temporary rank whilst in command of a Field Ambulance.

Dated February 1, 1916.—Ernest B. Knox, M.D.; Harry B. Connell; Hugh Stewart, M.B.

The notification of the promotion to temporary Lieutenant-Colonel of Major Arthur S. Arthur, which appeared in the *Gazette* of February 25, 1916, is in substitution for that which appeared in the *Gazette* of January 26, 1916.

Lieutenant-Colonel James William Barrett, late Australian Army Medical Corps, to be temporary Lieutenant-Colonel, dated February 29, 1916.

Gilbert Alexander Bannatyne, M.D., F.R.C.P., to be temporary Lieutenant-Colonel whilst employed at the Bath War Hospital, dated March 1, 1916.

Herbert Andrews Powell, M.D., F.R.C.S., to be temporary Honorary Lieutenant-Colonel whilst employed at the Guildford War Hospital, dated March 14, 1916.

Major Robert Jones, F.R.C.S.Edin., Royal Army Medical Corps, Territorial Force, to be temporary Lieutenant-Colonel, dated March 24, 1916.

Temporary Captain R. W. J., Earl of Donoughmore, to be temporary Lieutenant-Colonel whilst serving with the British Red Cross Society, dated March 29, 1916.

Temporary Honorary Captain S. W. Patterson to be temporary Honorary Major whilst serving with the Australian Voluntary Hospital, dated April 2, 1916.

Lieutenant-Colonel Thomas B. Winter is retained on the Active List under the Articles 120 and 522, Royal Warrant for Pay and Promotion, and to be supernumerary, dated February 22, 1916.

The undermentioned temporary Majors to be temporary Lieutenant-Colonels whilst in command of Field Ambulances:—

Dated July 1, 1915.—Percy A. Lloyd-Jones, D.S.O., M.B.

Dated October 15, 1915.—William G. Meydon, M.B.; Alexander M. Rose, M.B.

From October 15, 1915, to November 29, 1915, Wilfred C. Nimmo.

Dated December 5, 1915.—Arthur S. Arthur.

Dated December 6, 1915.—Thomas S. Dudding; Richard C. Hallowes, M.B.; Francis C. Sampson, D.S.O., M.B.

Dated September 17, 1915.—Major Eugene Ryan to be temporary Lieutenant-Colonel whilst in command of a Casualty Clearing Station.

The undermentioned Majors (temporary Lieutenant-Colonels) relinquish their temporary rank on re-posting:—

Dated August 14, 1915.—Charles R. L. Ronayne, M.B.

Dated August 27, 1915.—Francis P. Lauder.

Dated November 18, 1915.—Surgeon-Major W. S. Henderson, King Edward's Horse (The King's Oversea Dominions Regiment).

Major Charles H. Straton to be temporary Lieutenant-Colonel whilst an Assistant Director of Medical Services at headquarters of an Army, dated December 7, 1915.

William Donald Anderson to be temporary Major, dated March 25, 1916.

The undermentioned to be temporary Honorary Majors :—

Dated March 31, 1916.—William Ireland de Courcy Wheeler, M.D., F.R.C.S.I.; Temporary Honorary Lieutenant Lorimer J. Austin, M.B., F.R.C.S., whilst employed with No. 2 British Red Cross Hospital.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst in command of Stationary Hospitals:—

From September 4, 1914, to February 28, 1915.—Ernest A. Bourke.

From November 19, 1915, to January 19, 1916.—Harry C. Sidgwick, M.B.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst in command of Field Ambulances :—

Dated July 8, 1915.—George H. J. Brown, M.B., D.S.O.

Dated October 15, 1915.—Edward G. Anthonisz.

Dated December 18, 1915.—Edward M. Pennefather.

Dated January 17, 1916.—Temporary Major Charles E. Ligertwood.

The undermentioned Captains to be temporary Majors whilst in Command of Field Ambulances :—

From December 5, 1914, to October 14, 1915.—Edward G. Anthonisz.

Dated September 28, 1915.—Alan G. Wells.

Dated October 7, 1915.—William G. Wright.

Dated October 27, 1915.—Frank Worthington, M.B., D.S.O.

Dated January 20, 1916.—Philip S. Stewart, M.B.

Supernumerary Captain Robert Gale, M.B., is restored to the establishment, dated October 1, 1914.

The promotion to the rank of temporary Captain of Herbert T. du Heaume is antedated to March 27, 1915.

The undermentioned are granted temporary rank whilst employed at the County of Middlesex War Hospital:—

As Lieutenant-Colonel: Dated March 13, 1916.—Temporary Major Lancelot William Rolleston, M.B., from the Napsbury War Hospital. As Major: Temporary Captain Arthur O'Neill, from the Napsbury War Hospital. Dated March 20, 1916.—Lancelot Stephen Topham Burrell, M.D. As Captains: Dated March 25, 1916.—Hugh Frank Bodvell Roberts; Harold Cecil Halsted, M.D.

The undermentioned Captains to be temporary Majors whilst in command of Field Ambulances:—

From November 6, 1914, to June 30, 1915.—Percy A. Lloyd-Jones, D.S.O., M.B.

From September 16, 1915, to October 14, 1915.—Alexander M. Rose, M.B.

Dated September 17, 1915.—Winfrid K. Beaman.

From September 18, 1915, to October 14, 1915.—William G. Maydon, M.B.; Wilfred C. Nimmo.

Dated September 18, 1915.—Henry M. J. Perry.

Dated May 14, 1915.—Captain Ernest W. H. Groves, M.D., F.R.C.S., Royal Army Medical Corps, Territorial Force, to be temporary Major.

The promotion to the rank of temporary Captain of temporary Lieutenant Graham Smith, dated February 1, 1916, is cancelled.

Temporary Lieutenant Graham Smith is dismissed the Service by sentence of a General Court Martial, dated February 4, 1916.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst in charge of Stationary Hospitals:—

Dated January 1, 1916.—Andrew McMunn; Robert R. Lewis,

Major Edmond McDonnell, M.B., to be temporary Lieutenant-Colonel whilst in charge of a Casualty Clearing Station, dated January 6, 1916.

Major William F. McAllister-Hewlings, M.B., from Attached to Units other than Medical Units, to be Deputy Assistant Director of Medical Service, North Midland Division, dated February 15, 1916.

Major John Powell, M.B., is restored to the establishment, dated March 14, 1916.

Major Charles Virgil Nunez Lyne, Retired Pay, Indian Army, to be temporary Major, dated February 14, 1916.

John Jenkins to be temporary Major whilst employed at the Hammersmith Military Hospital, dated February 23, 1916.

George Douglas Gray, M.D., to be temporary Major, dated March 1, 1916.

Thomas Edward Holmes, M.D., to be temporary Major whilst employed at the Bagthorpe War Hospital, dated March 10, 1916.

Temporary Captain Samuel Fleming, M.B., to be temporary Major, dated March 12, 1916.

Captain John J. O'Keefe, M.B., to be temporary Major whilst in command of a Field Ambulance, dated December 16, 1915.

Temporary Honorary Major Sir John Collie, Knt., M.D., to be temporary Honorary Lieutenant-Colonel, dated March 10, 1916.

Bernard Hudson, M.D., to be temporary Honorary Major whilst serving with No. 2 Red Cross Hospital, dated April 23, 1915. (Substituted for the notification which appeared in the *Gazette* of July 26, 1915.)

Henry Sessions Southar, M.B., F.R.C.S., to be temporary Honorary Major whilst serving with the British Red Cross Hospital, Netley, dated March 1, 1916.

Temporary Honorary Major C. A. R. Nitch relinquishes his commission on ceasing to be employed with the British Red Cross Hospital, Netley, dated March 3, 1916.

Captain Robert G. Archibald, M.B., is seconded for service with the Egyptian Army, dated February 6, 1916.

Captain Avenell F. C. Martyn is seconded for service with the Egyptian Army, dated March 14, 1916.

Ernest William Skinner, M.D., to be temporary Captain, dated March 9, 1916.

Temporary Lieutenant George M. De Vine, M.B., to be temporary Captain, dated March 25, 1916.

Temporary Honorary Captain George Dreyer to be temporary Honorary Major, dated February 20, 1916.

Ralph Evelyn Drake-Brockman to be temporary Captain, dated February 16, 1916. (Substituted for the notification which appeared in the *Gazette* of March 7, 1916.)

Elfred Chalmers Austin, F.R.C.S., to be temporary Honorary Captain whilst employed at the Withington War Hospital, Manchester, dated March 31, 1916.

Captain Robert J. B. Buchanan, Half-pay List, retires on Retired Pay, dated March 25, 1916.

Lieutenant Daniel V. M. Adams, M.B., to be Captain, dated February 9, 1916. (Substituted for the notification which appeared in the *Gazette* of February 9, 1916, under the heading of Army Medical Service, Royal Army Medical Corps.)

Temporary Captain Sam Philips Bedson, M.D., from a Service Battalion, The Northumberland Fusiliers, to be temporary Lieutenant, dated March 1, 1916. (Substituted for the notification which appeared in the *Gazette* of March 7, 1916.)

The name of temporary Lieutenant Arthur Leslie Hanworth Rackham is as now described, and not as in the *Gazette* of December 19, 1914.

The name of temporary Lieutenant Malcolm Manson, M.B., is as now described, and not as in the *Gazette* of June 21, 1915.

The notification regarding temporary Lieutenant Sylvester D. Fairweather, M.B., which appeared in the *Gazette* of January 13, 1916, is cancelled.

The notification regarding temporary Lieutenant John R. McGilvray, M.B., which appeared in the *Gazette* of February 8, 1916, is cancelled.

Temporary Lieutenant Robert Ferguson Copland, M.B., is dismissed the Service by entence of a General Court-Martial, dated February 22, 1916.

Edward Wing Twining is granted the temporary honorary rank of Lieutenant whilst serving with the British Red Cross Hospital, Netley, dated March 5, 1916.

The appointment to a temporary Lieutenancy of George W. Gower, M.B., is antedated to August 5, 1915.

The date on which temporary Lieutenant-Colonel Sir Ronald Ross, K.C.B., F.R.S., F.R.C.S., relinquished his commission is November 30, 1915, and not as in the *Gazette* of December 23, 1915.

Temporary Captain (temporary Major) Allan N. Minns relinquishes the temporar rank of Major on ceasing to command a Field Ambulance, dated January 22, 1916.

The undermentioned temporary Captains relinquish their commissions:—

Dated February 5, 1916.—Laurence Maclagan-Wedderburn, M.D.

Hector Munro, M.B., relinquished his commission on February 13, 1916, and not as in the *Gazette* of February 8, 1916.

Dated March 31, 1916.—Claude H. Mills.

Dated February 18, 1916.—Captain (local Major) William F. Christie, M.B., relinquishes his local rank on ceasing to be senior Medical Officer at the Straits Settlements.

Dated March 13, 1916.—Temporary Captain Augustine S. Fry, M.B., relinquishes his commission on appointment to the Indian Medical Service.

The undermentioned temporary Lieutenants relinquish their commissions on account of ill-health:—

Dated March 10, 1916.—William H. Lambert, M.B.

Dated March 24, 1916.—Ezra N. Drier, M.D., F.R.C.S.Edin.
Dated March 30, 1916.—Cecil G. Sherowitz, M.B.; Frederick W. Lee.

Temporary Honorary Lieutenant Humphrey Nockolds, M.B., relinquishes his commission on ceasing to be employed with No. 3, British Red Cross Hospital, dated January 7, 1916.

Temporary Honorary Lieutenant W. Burt relinquishes his commission on ceasing to be employed with the British Red Cross Hospital, Netley, dated March 5, 1916.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated December 28, 1915.—David Thomas, F.R.C.S.
Dated January 25, 1916.—Thomas H. Brown.
Dated January 30, 1916.—Charles Birch.
Dated February 1, 1916.—Frank S. Scott, M.B.; Francis P. Halkyard, M.B.
Dated February 10, 1916.—Louis T. Eden, M.B.; Patrick Ashe; Herdman Porter, M.B.
Dated February 11, 1916.—Wallace C. G. Ashdowne, F.R.C.S.
Dated February 12, 1916.—Edward B. C. Mayrs, M.B.; James A. Cowie, M.D., F.R.C.S.
Dated February 14, 1916.—William Irving, M.D.
Dated February 15, 1916.—Burgess Barnett; Alexander Jamieson, M.B.; Thomas B. McKee, M.B.
Dated February 16, 1916.—Edward Johnson, M.B.
Dated February 18, 1916.—Alexander L. Grant, M.B.
Dated February 19, 1916.—Louis L. McKeever.
Dated February 20, 1916.—Charles W. Breeks, M.B.
Dated February 21, 1916.—John H. J. V. Coats, M.B.; Alfred C. Sandston.
Dated February 22, 1916.—George H. F. Graves.
Dated February 23, 1916.—William S. Baird, M.B.; Ernest W. H. Cruickshank, M.B.; James W. Martin, M.D.
Dated February 25, 1916.—Harry A. Sharman, M.D.
Dated February 26, 1916.—Lionel Pern; Ernest L. Marsh, M.B.
Dated February 27, 1916.—Alexander W. C. Lindsay; Philip O'C. White.
Dated February 29, 1916.—William E. Dean, M.D.
Dated March 1, 1916.—Christopher H. L. Rixon; Abraham E. Ellis; George H. Alabaster, M.B.; Edgcumbe W. Moore, M.B.; William Thomas.
Dated March 3, 1916.—William Fletcher, M.D.; George J. Adams, M.B., F.R.C.S.Edin.
Dated March 4, 1916.—Arthur E. Clarke; John H. Yule, M.B.
Dated March 8, 1916.—Sydney G. Tibbles; James L. O. Tilley.
Dated March 10, 1916.—Oswald Barton, M.B.
Dated March 12, 1916.—Laurence S. Morgan, M.B.
Dated March 17, 1916.—Frederic C. Barlow.
Dated March 24. 1916.—Neil Keith, M.B.; James A. Thoms, M.B.; William K. Hall, M.D.
Dated March 28, 1916.—Frederick S. Pope, M.D.

The undermentioned to be temporary Captains:—

Dated February 28, 1916.—Charles Newton Binney, M.B.
Dated March 13, 1916.—Alistair Sim Garden, M.B.
Dated March 14, 1916.—Gilbert James Arnold, F.R.C.S., late Captain, Royal Army Medical Corps, Territorial Force; Staff-Surgeon George Harley Ross, M.B., Retired List, Royal Navy.

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated October 10, 1915.—John H. V. Scott, M.B.
Dated November 9, 1915.—Ernest S. Hawthorne, F.R.C.S.I.
Dated November 21, 1915.—Peterswald Pattison, M.B.
Dated December 6, 1915.—Stephen Rowland, M.B.
Dated December 10, 1915.—James A. Montgomery, M.D.; Robert M. Boyd, M.B.
Dated December 28, 1915.—Sylvester D. Fairweather, M.B.
Dated December 29, 1915.—Frederick P. Fisher, M.B.
Dated December 30, 1915.—Harold B. Atlee, M.D.
Dated January 7, 1916.—George H. Steven, M.B.
Dated January 10, 1916.—Frederick Harris, M.B.
Dated January 15, 1916.—Robert C. Begg, M.B.
Dated January 18, 1916.—Walter N. Rishworth, M.B.
Dated January 26, 1916.—Thomas R. Trounce.

Dated January 29, 1916—John A. G. Burton, M.B.

Dated January 30, 1916.—John R. McGilvray, M.B.; Delbert Evans, M.B.

Dated January 31, 1916.—Horace S. Berry.

Dated February 1, 1916.—John W. Bingham, M.B.; Francis J. Henry, M.B., F.R.C.S.Edin.; Norman Duggan, M.B., F.R.C.S.; Kenneth D. C. Macrae, M.B.; Harold Edward Battle; John R. Forde, M.B.; Herbert T. Lukyn-Williams, M.B.; Douglas E. Derry, M.B.

Dated February 6, 1916.—Archibald H. Jacob; Henry B. Smith, M.B.; Sydney B. Faulkner, M.B.; Joseph Caton-Shelmerdine; Edward L. Mansel, M.D.

Dated February 7, 1916.—Thomas P. Herriot, M.B.; Francis E. Sprawson; Harold W. Wilson, M.B.

Dated February 8, 1916.—Charles G. G. Keane; Thomas E. Hammond, F.R.C.S.

Dated February 10, 1916.—Abram Leach, M.B.; Francis P. Evers, M.B.; Arthur L. Taylor, M.B.; William Campbell, M.B.; Laurence U. Geraty; George Leggat, M.B.; Christopher R. Dudgeon; Frank H. Woods; Llewellyn McI. Weeks, M.B.; John Macintyre, M.B.; Harold E. A. Boldero; Cedric S. L. Roberts; Henry A. Gillespie, M.B.; Henry C. Duffy, M.B.; Lennox R. Broster, M.B.; James P. Fitzpatrick; Eric S. Marshall; James I. P. Wilson, M.D., F.R.C.S.Edin.; Henry G. Frean, M.B., F.R.C.S.; Frederick A. Mills, M.B.; William T. Collier; Patrick Ashe; Joseph Marmion.

Dated February 12, 1916.—John T. Smeall, M.B.; John J. Dunne.

Dated February 13, 1916.—Harold A. Rowell; Ifan S. James; Edward B. Gunson, M.D.

Dated February 14, 1916.—Richard D. Fitzgerald, M.B.; Augustine S. Fry. M.B.

Dated February 15, 1916.—Harold D. Duke; John H. Wrightson, M.B.; Henry J. Milligan, M.D.; William R. G. Hamilton, F.R.C.S.I.; David C. Alexander. M.B.; Harold Ackroyd, M.D.; Sydney C. Tippett, M.B.; Arthur R. Chavasse, M.B.; George W. Davis, M.D.; Gavin Muir, M.B.; David A. D. Kennedy, M.B.; William H. Butler; John P. Walker, M.B.; Meredith M. Townsend; Gerald D. Shann; Frederick C. Barlow; Edward S. Gooddy, F.R.C.S.; George M. Mayberry; Carl F. Anthonisz; Hugh W. Fox; Frank Graveley; Charles W. Donald, M.D., F.R.C.S.Edin.; Frank G. Milne, M.B.

Dated February 16, 1916.—John Kirton, M.B.; Hadyn Peters; William F. Morgan; Robert Condy, M.D.; Ernest B. Leech, M.D.

Dated February 17, 1916.—Bernard Wallace; Harold E. Gamlen, M.B.; Edward L. Horsburgh, M.D.; Thomas T. Higgins, M.B., F.R.C.S.

Dated February 18, 1916.—George B. MacGregor, M.B.; Thomas Lovett, M.B.; Samuel C. Westwood, M.D.; Alfred Merrin; Matthew A. Swan, M.B.; Edward S. B. Eames; George A. Borthwick, M.B.; Horace L. Mann; Hubert W. Ward; Maurice J. Mottram; Donald F. Shearer, M.B., F.R.C.S.; John F. Steven, D.S.O., M.B.; Austin C. Giles, M.B.; Thomas F. Griffin, M.D.

Dated February 19, 1916.—William H. Anderson; John Ferguson, M.B.

Dated February 20, 1916.—Lawrence H. C. Birkbeck, M.B.; Thomas J. S. Moffett, M.D.; Robert C. Matson; Edwin C. Hardwicke; John E. O'Loghlan.

Dated February 21, 1916.—Stephen J. Henry, M.B.; Ernest G. Wheat, M.D.

Dated February 22, 1916.—Stephen W. Coffin; Leonard G. Brown; Percy E. Lones; Robert J. McN. Love, M.B.

Dated February 23, 1916.—Philip W. McKeag, M.B.; Alexander Paterson, M.B.; Joseph McCulloch, M.B.; Frederick D. Atkins, M.B.; James T. Gunn, M.B.; James R. Murray, M.D.; George J. Bowen; Colin Hunter; David S. Brough, M.B.

Dated February 24, 1916.—Clement T. Neeve, M.B., F.R.C.S.; Victor J. Woolley, M.D.; Dougan Bird.

Dated February 25, 1916.—Harold G. Oliver; John J. Crawford, M.D.; James McDonnell; John S. Taylor, M.B.

Dated February 26, 1916.—Roderick A. Steven, M.B.

Dated February 27, 1916.—Felix E. R. Laborda; Cletus McShane, M.B.; George N. Lorimer, M.B.

Dated March 1, 1916.—Alexander Fraser, M.B.; George D. Cairns, M.B.; Arthur P. Saint; Bernard B. Westlake; George M. Jones; Sidney K. Vines; Andrew T. Cunningham, M.B.; Samuel A. Montgomery, M.B.; Edward S. Hall, M.B.; Andrew F. Readdie; Christopher Sullivan, F.R.C.S.I.; Arthur C. Turner; Reginald H. Tribe; Robert M. Johnstone, M.B.; Edward C. Dutton, M.B., F.R.C.S.Edin.; William H. Stott; William J. Lascelles, M.B.; Alexander G. MacLeod, M.B.; Ernest A. O. Travers; Philip Carney, M.B.; William Thomas; Gideon R. E. Colquhoun.

Dated March 2, 1916.—Arthur J. W. Compton, M.B.
Dated March 3, 1916.—Francis C. Macauly, M.B.; Edgar W. Smerdon, M.D., F.R.C.S.
Dated March 5, 1916.—Alfred H. Conder.
Dated March 6, 1916.—John H. Askins, M.B.
Dated March 7, 1916.—Frederic P. Joscelyne, M.D.
Dated March 8, 1916.—George S. Deane; Alan F. Rook; Harold S. Sugars, M.B.; Francis G. Bell, M.D., F.R.C.S.; Frederick O. Clarke, M.B.; John H. Tomlinson; Robert L. Kitbhing, M.B.; John T. Heffernan; Eric M. Townsend; Henry H. Elliott, M.B.; John Sullivan, M.B.
Dated March 9, 1916.—Hubert L. C. Noel; George S. Phillips; Matthew E. Robinson, M.B.; Hugh N. M. Puckle, M.B.; Reginald M. Clarke, M.B.; Alan T. Roberts, M.B.; George D. K. Waldon, M.B.; James I. M. Jamieson, M.B.; William E. Giblin, M.B.; William A. Edwards, M.B.; Leslie J. J. Nye, M.B.; Francis E. Keane, M.B.
Dated March 10, 1916.—Oswald H. Edwards; Francis Irvine, M.B.; Walter Smithies; Henry H. Davis, F.R.C.S.Edin.; Charles E. Sundell, M.D.; John R. Slack, M.B.; Timothy Sheehan; Alan Wiley; Francis S. Hawks; James A. Hutchinson; Frederick H. Rudge; Norman G. Horner, M.B.; Douglas C. Taylor, M.B., F.R.C.S.; William W. Turner, M.B.; William M. O'Connor, M.B.
Dated March 11, 1916.—Edgar Taunton, M.B., F.R.C.S.
Dated March 12, 1916.—Horace B. Binks, M.B.; Alexander H. Davidson, M.B.; Arthur C. Freeth, M.B.
Dated March 15, 1916.—Michael L. Neylon; Norman W. Steinberg, M.B.; James Hutchison, M.D.; George Riddoch, M.B.; Victor J. McAllister, M.B., F.R.C.S.I.; William W. Thomson, M.B.; Arthur T. Paterson, M.D., F.R.C.S.Edin.; Arthur C. A. Jekyll, M.B.; Cedric K. Cohen, M.B.; Eric P. Dark, M.B.
Dated March 16, 1916.—Russel V. Steele, M.B.; Sidney E. Elphick; Edward J. Eedle; Richard B. Hunt; Charles Stuart, M.D.; Montague A. Farr; Hamilton Mathewson, M.B.
Dated March 17, 1916.—John W. Wood; John S. Caldwell, M.B.; William Morrison, M.B.; Rowland H. Scovell, M.B.; Owen H. Bowen.
Dated March 18, 1916.—James Boyd, F.R.C.S.Edin.
The undermentioned to be temporary Lieutenants:—
Dated January 29, 1916.—Lawrence Fitzhenry McDowell, M.D.
Dated February 8, 1916.—George Cuthbert Robinson; John Colgan, M.B.; Arthur Gerard East, M.B.
Dated February 10, 1916.—Albert Henry Beaumont Kirkman, F.R.C.S.Edin.; William Joseph MacDonald, M.B.; Martin William Loy; James Dunlop, M.B.
Dated February 11, 1916.—Charles Stamford Read, M.D.
Dated February 12, 1916.—Claude Reginald Wright; Bertrand Kemp Jackson, whilst employed as a Dental Surgeon.
Dated February 13, 1916.—William Hume Hart, M.B.
Dated February 14, 1916.—Henry Aloysius Boyle, M.B.; Stanley Ewart Bethell, M.B.; Charles Arthur Lovatt Evans; George Christopher Metcalfe; Robert Alexander Slater, M.B.; Angus Cameron Mackay; William Corbet, M.B.; John Howard Waterhouse, M.D.; Ernest Charles Edward Barnes; George Greensill Old, M.B.; Edmund Rupert Dermer; Arthur Daniel Morris; James Bryce Robertson, M.B.
Dated February 15, 1916.—Second Lieutenant Joseph Herbert Porter, M.B., from The Royal Fusiliers (City of London Regiment); Second Lieutenant Thomas William Gerald Johnson, M.B., from The Connaught Rangers; John Black Stevenson, M.B.; Walter James Dilling, M.B.; Kenneth Thomas Limbery; Leonard Robert Pickett; David MacCulloch Brown, M.D.; Anstir McCawley; David John Evans; Charles Walsham Webb, M.D.; John Aylmer Tippett; Charles Kingsley Carroll; Peter Hutchison Young, M.B.
Dated February 16, 1916.—James Burnett Rae, M.B.; John Macdonald Ross, M.B.; James Bryce Robertson, M.B.; Ralph Evelyn Drake-Brockman; Charles Ignatius Hannigan, M.B.
Dated February 17, 1916.—Alan Nigel Drury, M.B.
Dated February 18, 1916.—Arthur Charles Duncan Newton; Osmond Whitechurch Gange; John Gordon Leslie, M.B.
Dated February 20, 1916.—Lambert Arthur Wellesley Johnson.
Dated February 21, 1916.—Edward Kynaston Williams; James McHaffie, M.D.; Cecil Dermot Coyle, M.B.; Norman Garrard; Leonard Grugeon Reynolds; Herbert

Mohan, M.D.; John James Tate; George Lynn Pillans; William Lyle Paterson; Douglas James Bedford; Edwin Lancelot Hopkins; Louis Jerome O'Donovan; Andrew Francis Wilson-Gunn, M.B.; William Henry Pearse; John Ritchie Brown, M.B.; Claude Bartley Tudehope, M.B.; Anthony Traill, M.B.

Dated February 22, 1916.—Michael Moran; Lewis Mendel Mayers; Andrew Ronald Mitchell, M.D.; William Ormerod Welply, M.D.; John Arthur West; Stewart McNaughton, M.D,

Dated February 23, 1916.—James Miller Stalker, M.B.; Douglas Crellin; Patrick Black; Leonard Fabian Hirst, M.D.; George William Young, M.D.

Dated February 24, 1916.—Alexander Sandison, M.B.; Rupert Conrad Hewitt.

Dated February 25, 1916.—Joseph Conor O'Farrell; Lieutenant Thomas Powrie Buist, M.B., from Unattached List, Territorial Force; William Edmund Taylor; George Michael De Vine, M.B.

Dated February 26, 1916.—Harry Hannigan, M.B.; John Woollaston Wayte.

Dated February 28, 1916.—Charles Henry Farley Bailey; Anthony Hagarty Corley.

Dated March 1, 1916.—David Page Thomas; Alfred Gahagan Alexander, M.D.; William George Harnett, M.D.; Andrew John Chillingworth; Herbert Meredith Harrison; Richard Aloysius Quinn, M.B.; James Ignatius Enright, M.B.; Charles Edward Gooderson Bateman; John Glyndor Treharne Thomas: Bernard Sangster Simmonds, M.B.; Donald Saunders Graham; Alfred Arthur Edmund Newth, M.B.; John Robert Wylie, M.B.; Henry William Harding, M.D.; James Young; Godfrey Charles Browne Hawes: Arthur Edwin Foerster; Cecil Wilmot Morrison, M.B.; Wiliam James Porteous, M.B.; James Scott Annandale, M.B.; Arthur John Desmond Rowan, M.B.; Arthur Morgan; William Gordon Weston, M.B.; James St. John Dundon, M.B.; Charles Reginald Howard, M.D.; Joseph Thomas Herbert Madill, M.B.; Nathaniel Joseph Judah, M.B.; John Burnet Yelf; John Fraser Mackenzie, M.B.; James Ernest Manlove; Cusack O'Malley, M.B.; Sydney Colin Warneford Iredale; Gerald Bovell Mason; Cecil Townshend, M.D.; Temporary Lieutenant Sam Philips Bedson, M.D., from The Northumberland Fusiliers.

Dated March 4, 1916.—Cecil Ledward Forde, M.B.; Peter Alexander McCallum, M.B.; Thomas Ronald Davey; Christopher Costello, M.B.; Archibald Alastair Bruce Scott, M.B.; William Scot; William Henry Soady; Ernest Nuttall; John Kerr Bell; John Cathcart, M.B.; John Joseph Dowdall, M.B.; William Henry Thomas; Walter Joseph Murphy; James Coburn Anderson, M.B.; Robert Corbett Corbett, M.B.

Dated March 6, 1916.—William George Thomas; Edwin Bertram Morley, M.B.

Dated March 7, 1916.—John Francis Nicholson, M.D.; Raymond Barclay Gorst, M.B.; Douglas Arthur Crow, M.B.; Geoffrey Leo Lawlor; James Butler Fairclough; Samuel Alexander McClintock, M.D.; Andrew Hamilton Arnott, M.B.; Philip Crawford Conran; Alexander Chester Lambert, M.D.; Rory Eric McLaren, M.D.

Dated March 8, 1916.—Ignatius O'Keeffe, M.B.; Eric Craigie Lindsey.

Dated March 9, 1916.—Richard Vincent Murphy.

Dated March 10, 1916.—Walter Gilmour Keys; Richardson Alexander Broughton Stilley.

Dated March 11, 1916.—John Hewat, M.B.

Dated March 13, 1916.—William Cowan Holburn.

Dated March 14, 1916.—Frank Llewellyn Gill, M.B.; Hugh Selwyn Gaskell, M.B.; Daniel Morrison, M.B.; Patrick Joseph Maguire; Thomas Randolph Hunter; Edward James Dermott; David Campbell Suttie, M.B.; George Fitzwilliam Forde; William John McIvor, M.B.; Robert James Patrick Waugh, M.B.; William Halliwell, M.B.; Bertram Pulvermacher Allinson; Thomas Warren Mason; George John Knaggs; Robert William Chapman, M.B.; Alfred Walker, M.D.; William Jones Evans James Alexander Hamilton Telfer, M.B.; Francis John Henderson Begg, M.B.

Dated March 15, 1916.—Temporary Honorary Lieutenant John Nissen Deacon, M.B.; Thomas Perrin, M.D., F.R.C.S.; Frederick Leonard Keith, M.B.; Herman Arthur Macdonald, M.B.; Theodore Paton Hutchison, M.B.; John Lawrence Power.

Dated March 16, 1916.—Harold Tipping, M.D.; William Alexander Shafto, M.D.; Allan Pimm.

Dated March 17, 1916.—John Edward Harford, M.B.; William Woodthorp Williams Watt.

Dated March 18, 1916.—Philip Figdor, M.B.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated February 13, 1916.—Gordon Cranstoun; Harold Gardiner-Hill.

Dated February 15, 1916.—Geoffrey Oliver Hempson ; Geoffrey Marr Vevers.
Dated February 16, 1916.—Edgar Broughton Barnes.
Dated February 17, 1916.—Leslie William Jones.
Dated February 19, 1916.—George Stanley Graham, M.B.
Dated February 22, 1916.—Arthur Wilfrid Adams; Nicholas Marshall Cummins, M.B.; William Leslie Thomas.
Dated February 23, 1916.—Llywelyn ap Ivan Davies.
Dated February 26, 1916.—Thomas Anwyl-Davies.
Dated February 29, 1916.—Eric Gordon Dingley ; Philip Hewer Wells.
Dated March 8, 1916.—Samuel Reginald Prall.
Dated March 9, 1916.—William Thomas.

The undermentioned Lieutenants of the Canadian Army Medical Corps to be temporary Lieutenants :—

Dated January 31, 1916: Philo William Tuller, M.D. ; James Ernest Carmichael, M.D.: Alfred Ernest Whitmore, M.D.; Robert Charles Robinson, M.D.; William Samuel Thomas Connell, M.D.

Dated February 1, 1916.—David Main Baillie, M.D.

Dated February 9, 1916.—Roy Percy Smith, M.B.; William Murdoch McLaren, M.B.

Dated March 2, 1916.—Donald Ernest Howell Cleveland, M.D.; John Brady Galligan, M.B.; Thomas Archibald MacKenzie, M.B.; Frederick Heman Hurlburt, M.B.: Maurice Daniel Baker, M.B. ; Emerson Charles Smith; Donald Thomas Evans, M.B.; John Gagen Lee, M.B.; George Anderson Lamont, M.B.

The undermentioned Quartermaster and Honorary Captain to be Honorary Major :—

Dated March 29, 1916.—George L. Allen, Retired Pay, Royal Army Medical Corps.

The undermentioned to be temporary Quartermasters, with the honorary rank of Lieutenant :—

Dated February 7, 1916.—Mawer Dougall Cowtan.
Dated February 28, 1916.—Archibald Gillespie: Archibald Crosby Truman.
Dated March 2, 1916.—George Berrisford Walker.

Temporary Quartermaster and Honorary Lieutenant Herbert J. Middleweek relinquishes his commission on ceasing to be employed with No. 2 British Red Cross Hospital, dated January 15, 1916.

Temporary Quartermaster and Honorary Lieutenant William S. Gibson relinquishes his commission, dated February 25, 1916.

TERRITORIALS.

Royal Army Medical Corps.

1st *Northern General Hospital.*—Captain Thomas M. Allison, M.D., to be Major, dated March 21, 1916; Captain James W. Heslop, from the Territorial Force Reserve, to be Captain, dated January 16, 1915; Lieutenant Herbert G. Dodd, M.B., to be Captain, dated February 16, 1916; Lieutenant Herbert W. Kerrigan, M.B., to be Captain, dated March 1, 1916.

4th *Northern General Hospital.*—Major Edward Mansel Sympson, M.D., to be Lieutenant-Colonel, dated March 16, 1916.

2nd *Scottish General Hospital.*—Lieutenant John W. Simpson, M.B., to be Captain, dated January 9, 1916.

Highland Mounted Brigade Field Ambulance.—Lieutenant William H. Milligan to be Captain, dated December 1, 1915; Captain Andrew Mowat, M.B., to be temporary Major whilst in command of a Field Ambulance, dated March 25, 1916.

1st *Highland Field Ambulance.*—Guy Torrance, M.B., to be Lieutenant, dated December 31, 1915.

3rd *Highland Field Ambulance.*—Lieutenant Charles G. Skinner to be Captain, dated February 25, 1916.

Highland Casualty Clearing Station.—Captain John Dow, M.B., relinquishes his commission on appointment to the Indian Medical Service, dated March 13, 1916.

1st *Lowland Field Ambulance.*—Lieutenant (temporary Captain) Neil MacInnes, M.B., to be Captain, dated December 19, 1914.

2nd *Lowland Field Ambulance.*—Major Matthew Dunning, M.B., to be temporary Lieutenant-Colonel whilst in command of a Field Ambulance, dated November 14, 1915; Lieutenant Harry T. Findlay, M.B., to be Captain, dated February 10, 1916; Lieutenant William Combe, M.B., to be Captain, dated March 15, 1916; Quarter-

master and Honorary Lieutenant James Law relinquishes his commission on account of ill-health, dated March 5, 1916.

3rd Lowland Field Ambulance.—The undermentioned Lieutenants to be Captains; Neil Scott, M.B., F.R.C.S., dated December 7, 1915; James W. G. H. Riddel, dated January 21, 1916; Robert Lawson, M.B., dated January 22, 1916; Captain Robert B. Barnetson, M.B., relinquishes his commission, dated February 26, 1916.

3rd Northumbrian Field Ambulance.—Lieutenant Patrick J. Sheedy to be Captain, dated March 6, 1916.

2nd West Riding Field Ambulance.—Quartermaster and Honorary Captain James Boswell is granted the honorary rank of Major, dated November 11, 1915; Lieutenant Clement H. Heppenstall, M.B., relinquishes his commission on appointment to the Indian Medical Service, dated March 13, 1916.

3rd West Riding Field Ambulance.—Captain (temporary Major) William S. Kerr, M.B., F.R.C.S.Edin., to be Major, dated November 7, 1915; Major William S. Kerr, M.B., F.R.C.S.Edin., to be temporary Lieutenant-Colonel whilst in command of a Field Ambulance, dated January 1, 1916; John Millie Pringle, M.B., to be Lieutenant, dated March 14, 1916.

Yorkshire Mounted Brigade Field Ambulance.—Captain Alfred H. Benson to be temporary Major whilst in command of a Field Ambulance, dated March 16, 1916.

Welsh Border Mounted Brigade.—Arthur Burgess to be Second Lieutenant (on probation), dated December 13, 1915.

1st Welsh Field Ambulance.—Lieutenant James Ernest Dunbar, M.B., from South Wales Mounted Brigade Field Ambulance, to be Lieutenant, dated September 24, 1915.

South Wales Mounted Brigade Field Ambulance.—Lieutenant Norman T. K. Jordan, M.B., to be Captain, dated February 6, 1916.

Welsh Border Mounted Brigade Field Ambulance.—James Derham Reid to be Lieutenant, dated March 17, 1916; Lieutenant William Morgan resigns his commission, dated March 29, 1916.

West Lancashire Divisional Sanitary Section.—Lieutenant Alfred Reid, from 1st London Sanitary Company, to be Lieutenant, dated March 11, 1916.

3rd West Lancashire Field Ambulance.—Arthur Stanley Parkinson. M,D., to be Lieutenant, dated March 11, 1916. Captain Walter R. Stephen, M.B., is dismissed from His Majesty's Service by sentence of a General Court-Martial, dated January 26, 1916.

East Lancashire Casualty Clearing Station.—Lieutenant (temporary Captain) Thomas B. Wolstenholme, M.B., to be Captain, dated April 1, 1915.

1st East Lancashire Field Ambulance.—Major William L. Bentley to be temporary Lieutenant-Colonel whilst in command of a Field Ambulance, dated December 22, 1915; Quartermaster and Honorary Lieutenant Norman C. Frye relinquishes his commission on account of ill-health, dated March 23, 1916.

3rd East Lancashire Field Ambulance.—Major Thomas Holt, M.D., to be temporary Lieutenant-Colonel, dated February 12, 1916; Lieutenant Arnold B. Thompson, M.B., to be Captain, dated November 1, 1915; Major Frederick W. Marsden, relinquishes his commission on account of ill-health, dated March 5, 1916.

1st South Midland Mounted Brigade Field Ambulance.—Lieutenant William G. Rutherford to be Captain, dated March 13, 1916.

1st South Midland Field Ambulance.—Captain Henry N. Burroughes, M.B., from Attached to Units other than Medical Units, to be Captain, dated March 17, 1916; Edward Gordon Anderson, M.B., to be Lieutenant, dated March 11, 1916.

2nd South Midland Field Ambulance.—Lieutenant William J. F. Craig to be Captain, dated March 6, 1916; Lieutenant James Bannerman to be Captain, dated March 9, 1916; Lieutenant Henry N. Crowe, M.D., to be Captain, dated March 11, 1916.

3rd South Midland Field Ambulance.—Lieutenant-Colonel James Young, M.D., is seconded whilst holding an appointment as Assistant Director of Medical Services, dated February 18, 1916; Lieutenant William G. McKenzie to be Captain, dated February 14, 1916.

South Midland Casualty Clearing Station.—Major Peverell S. Hichens, M.D., to be temporary Lieutenant-Colonel whilst in command of a Casualty Clearing Station, dated March 11, 1916; Alexander Gray Banks, M.D., F.R.C.S.Ed., to be Lieutenant, dated March 29, 1916; Cyril Alban Raison, M.B., to be Lieutenant, dated March 29, 1916.

North Midland Mounted Brigade Field Ambulance.—Lieutenant Sydney A. S. Malkin to be Captain, dated February 5, 1916.

North Midland Divisional Sanitary Section.—Lieutenant Adam White, M.B., to be Captain, dated December 1, 1915.

1st North Midland Field Ambulance.—Lieutenant Thomas E. A. Carr, M.B., to be Captain, dated March 17, 1916.

2nd North Midland Field Ambulance.—Captain (temporary Major) Herbert A. Howes, 4th Battalion, The Lincolnshire Regiment, to be Major (temporary), dated March 18, 1916; Lieutenant (temporary Captain) Claude M. Cowper relinquishes his commission on account of ill-health, dated March 5, 1916.

3rd North Midland Field Ambulance.—Captain John G. J. Green relinquishes his commission on appointment to the Indian Medical Service, dated March 13, 1916.

1st East Anglian Field Ambulance.—Lieutenant Simmon D. Graham, M.B., to be Captain, dated December 19, 1915; Captain Laurence H. Hutchins relinquishes his commission on account of ill-health, dated March 24, 1916; Lieutenant (temporary Captain) Gilbert C. Gray to be Captain, dated April 1, 1915. The following announcement is substituted for that which appeared in the *London Gazette* of March 7, 1916: Captain Gilbert C. Gray relinquishes his commission on account of ill-health, dated March 8, 1916; Lieutenant Ralph J. R. Mecredy, from 3rd East Anglian Field Ambulance, to be Lieutenant, April 2, 1916.

2nd East Anglian Field Ambulance.—Lieutenant Arthur Greene, M.D., F.R.C.S., to be Captain, dated January 14, 1916.

3rd East Anglian Field Ambulance,—Lieutenant Roy D. Langdale-Kelham to be Captain, dated February 20, 1916; Lieutenant William K. Legassick is seconded for duty with 4th Battalion, The Queen's Own (Royal West Kent) Regiment, dated February 10, 1916; Lieutenant Ralph J. R. Mecredy is restored to the establishment, dated April 2, 1916.

1st Wessex Field Ambulance.—Lieutenant Ernest H. Helby to be Captain, dated January 26, 1916.

3rd Wessex Field Ambulance.—Captain Frank L. Dickson, M.B., relinquishes his commission on account of ill-health, dated March 16, 1916: Serjeant-Major Joshua Lewis to be Quartermaster, with the honorary rank of Lieutenant, dated March 15, 1916.

Wessex Casualty Clearing Station.—Lieutenant Charles Telfer to be Captain, dated February 24, 1916; Lieutenant Thomas J. Wright, F.R.C.S.Ed., to be Captain, dated March 13, 1916; Lieutenant James Fenton, M.B., from Attached to Units other than Medical Units, to be Lieutenants, dated March 17, 1916; Walter Silverwood Richardson, F.R.C.S.Edin., to be Lieutenant, dated March 9, 1916.

Wessex Divisional Sanitary Section.—Lieutenant Arthur E. Bonham to be Captain, dated February 12, 1916.

1st Eastern General Hospital.—Lieutenant Orlando Inchley to be Captain, dated January 23, 1916.

Eastern Mounted Brigade Field Ambulance.—Lieutenant Vernon M. Wallis to be Captain, dated November 8, 1915. The following to be Lieutenants, dated March 29, 1916: Eugene Henry Coyne, M.B.; Patrick Joseph Smyth, M.B.

1st Western General Hospital.—Lieutenant Leslie Oldershaw to be Captain, dated October 10, 1915.

2nd Western General Hospital.—Lieutenant Frank H. Lacey, M.B., to be Captain, dated December 8, 1915; Lieutenant James G. McKinlay, M.B., to be Captain, dated December 14, 1915,

3rd Western General Hospital.—Lieutenant Joseph Lloyd, M.D., to be Captain, dated February 4, 1916; Lieutenant Rhys T. Jones to be Captain, dated February 19, 1916; Lieutenant Cornelius C. Boyle, M.B., to be Captain, dated March 3, 1916; Lieutenant John T. Williams, M.D., to be Captain, dated March 4, 1916.

1st Southern General Hospital.—Captain Harold B. Whitehouse is seconded, dated March 14, 1916; Lieutenant Richard W. Acheson to be Captain, dated February 12, 1916; Lieutenant Koch H. Gill, M.B., to be Captain, dated March 6, 1916; Lieutenant Geoffrey L. Wilkinson to Captain, dated March 8, 1916.

2nd South-Western Mounted Brigade Field Ambulance.—Lieutenant Charles D. Relton, M.B., to be Captain, December 6, 1916; Lieutenant Hubert R. Dive to be Captain, dated December 20, 1915.

1st Home Counties Field Ambulance.—Lieutenant Archdale L. Sharpin to be Captain, dated December 26, 1915.

2nd Home Counties Field Ambulance.—Christian Cathcart Robinson, M.B., to be Lieutenant, dated March 29, 1916.

3rd Home Counties Field Ambulance.—Lieutenant John J.C. Hamilton to be Captain, dated February 1, 1916. The date of apppointment of Transport Officer and Honorary Lieutenant Walter P. Barringer is March 2, 1915, and not as stated in the *London*

Gazette of April 14, 1915. The date of appointment of Quartermaster and Honorary Lieutenant Frank A. Armstrong is February 19, 1915, and not as stated in the *London Gazette* of March 13, 1915.

Home Counties Divisional Sanitary Section.—Captain Arthur E. Tait, M.B., from 3rd North Midland Field Ambulance, to be Captain, dated March 3, 1916.

Home Counties Casualty Clearing Station.—Captain Richard W. Brimacombe to be temporary Major whilst in command of a Casualty Clearing Station, dated April 2, 1916.

1*st London* (*City of London*) *General Hospital.*—Major James Calvert, M.D., to be Lieutenant-Colonel, dated March 25, 1916; Captain Frederick W. Andrewes, M.D., F.R.S., to be Major, dated March 25, 1916.

1*st London* (*City of London*) *Field Ambulance.*—Captain Francis V. Denne, from Attached to Units other than Medical Units, to be Captain, dated March 9, 1916.

1*st London Field Ambulance.*—Quartermaster-Serjeant William Culver, from 6th Battalion, The London Regiment, to be Quartermaster, with the honorary rank of Lieutenant, and seconded for service with 6th Provisional Brigade Field Ambulance, dated February 25, 1916.

1*st London* (*City of London*) *Sanitary Company.*—The undermentioned Lieutenants to be Captains: Major Greenwood, dated February 9, 1916; Percival Hartley, dated February 10, 1916; Ernest R. Matthews, dated February 28, 1916. Lieutenant George L. Matthews to be Captain, dated February 28, 1916.

2*nd London General Hospital.*—Captain Kenneth B. Clarke relinquishes his commission on account of ill-health, dated March 5, 1916.

2*nd London* (*City of London*) *General Hospital.*—Lieutenant Robert J. W. A. Cushing to be Captain, dated February 20, 1916.

2*nd London* (*City of London*) *Field Ambulance.*—Captain Harold K. Griffith, M.B., F.R.C.S., from Attached to Units other than Medical Units, to be Captain, dated February 27, 1916; Lieutenant Arthur H. Platt to be Captain, dated October 24, 1915.

2*nd London Sanitary Company.*—Lieutenant Arthur E. Rayner to be Captain, dated November 2, 1915; Captain Donald P. M. Farquharson, M.B., from Attached to Units other than Medical Units, to be Captain, dated March 11, 1916; Lieutenant Charles D. Edwards, M.D., to be Captain, dated February 2, 1916; Lieutenant Thomas J. Murray to be Captain, dated February 7, 1916; Lieutenant Osmond Cattlin to be Captain, dated February 20, 1916; Tam Legge to be Lieutenant, dated March 3, 1916; William Johnson, M.B., to be Lieutenant, dated March 11, 1916; Charles Nelson Atlee to be Lieutenant, dated March 25, 1916; Arthur Ernest Jury to be Lieutenant, dated March 29, 1916.

3*rd London* (*City of London*) *Field Ambulance.*—Michael John Hackett, M.B., to be Lieutenant, dated March 3, 1916; Transport Officer and Honorary Lieutenant Cyril Norton resigns his commission, dated February 24, 1916.

3*rd London Field Ambulance.*—The appointment of Michael John Hackett, M.B., as Lieutenant, which was announced in the *London Gazette* of March 2, 1916, is cancelled.

3*rd London General Hospital.*—The undermentioned Lieutenants to be Captains: Lieutenant Walter H. Lloyd, dated February 13, 1916; Douglas N. Hardcastle, dated February 15, 1916; Albert W. Bowie, M. B., dated February 15, 1916; Lieutenant Harry G. Mallam, dated February 16, 1916; Louis A. Celestin, dated February 19, 1916; Walter L. Holyoak, M.B., dated February 21, 1916.

4*th London General Hospital.*—Major (temporary Colonel, Army Medical Service) Alfred H. Tubby, M.B., F.R.C.S., to be Lieutenant-Colonel, and remain seconded, dated February 23, 1916. The undermentioned Captains to be Majors: Frederick F. Burghard, M.D., F.R.C.S., and remain seconded, dated February 23, 1916; Alfred M. Gossage, M.B., dated February 23, 1916; Herbert F. Waterhouse, M.D., F.R.C.S., dated February 23, 1916; Temporary Captain George E. Nash to be Captain, dated April 1, 1915; Quartermaster and Honorary Lieutenant Simon Duparc is seconded, dated March 23, 1916; Serjeant-Major Edmund John Weston to be Quartermaster, with the honorary rank of Lieutenant, dated March 23, 1916.

5*th London General Hospital.*—The undermentioned Lieutenants to be Captains, dated February 16, 1916: Philip G. Doyne; William J. T. Kimber; Harold M. Harwood; Henry A. Philpot, M.D.

Attached to Units other than Medical Units.

The date of promotion of Lieutenant Percival T. Rutherford to Captain is October 8, 1914, and not as announced in the *London Gazette* of May 6, 1915.

Major Walter M. Hamilton, M.D., from the Territorial Force Reserve, to be Major, dated November 5, 1915.

Lieutenant Charles C. Ling to be Captain, dated November 28, 1915.

The date of appointment of Lieutenant Edward M. de Jong is December 10, 1915, and not as stated in the *London Gazette* of January 3, 1916.

Lieutenant John de Ville Mather, M.D., to be Captain, dated January 3, 1916.

Lieutenant Henry W. Godfrey, M.D., to be Captain, dated January 27, 1916.

The following announcement is substituted for that which appeared in the *London Gazette* of January 21, 1916:—

William Layard Griffiths, M.D., F.R.C.S. (late Captain, Royal Army Medical Corps, Territorial Force), to be Captain, dated February 12, 1916.

Lieutenant Frederick A. Pring to be Captain, dated February 19, 1916.

Captain David E. Dickson, M.B., to be Major, dated February 20, 1916.

Lieutenant Wilfrid P. Tindal-Atkinson to be Captain, dated February 20, 1916.

Percy Gordon Williamson, M.B. (late Captain, 5th Battalion, The Prince of Wales's Own, West Yorkshire Regiment), to be Captain, dated February 21, 1916.

Captain George E. Nash, from 4th London Field Ambulance, to be Captain, dated March 5, 1916.

Lieutenant Leonard S. Willox, M.D., to be Captain, dated March 7, 1916.

Captain William R. E. Williams to be Major, dated March 12, 1916.

Major George S. Mill, M.D., relinquishes his commission on account of ill-health, dated March 24, 1916.

Harold Jacques to be Lieutenant, dated March 25, 1916.

Captain Thomas M. Morton to be Major, dated March 26, 1916.

Percy Albert Chillcott to be Lieutenant, dated March 29, 1916.

Captain James J. Marsh relinquishes his commission on account of ill-health, dated March 30, 1916.

Lieutenant Frank R. Fletcher, M.B., to be Captain, dated April 1, 1915.

Lieutenant Herbert Connop to be Captain, dated April 27, 1915.

Lieutenant Harry L. Gaunlett to be Captain, dated April 1, 1915.

SPECIAL RESERVE.

Captain Hugh G. Trayer, M.B., to be temporary Major whilst commanding a Field Ambulance, dated November 24, 1915.

Lieutenant (on probation) Allan A. Duffus resigns his commission, dated November 25, 1915.

Captain Clement Lovell, M.D., to be temporary Major whilst commanding a Field Ambulance, dated December 31, 1915.

Captain George V. Stockdale, M.B., to be temporary Major whilst commanding a Field Ambulance, from January 4 to February 7, 1916.

The undermentioned Lieutenants to be Captains:—

Dated February 25, 1916.—Alan R. Laurie.

Dated February 27, 1916.—John T. Scrogie, M.B.

Dated March 1, 1916.—Robert F. Walker, M.B.

Dated March 9, 1916.—Herbert T. Chatfield, M.B.

Dated March 11, 1916.—Alexander L. C. Mackenzie.

Captain Paul B. Roth, M.B., relinquishes his commission on account of ill-health, dated March 18, 1916.

Transport Officer and Honorary Lieutenant Lawrence W. Wethered, from 6th London Field Ambulance, to be Transport Officer with the honorary rank of Lieutenant, dated March 5, 1916.

Quartermaster and Honorary Lieutenant James M. Munro, from Highland Casualty Clearing Station (seconded for duty with 2nd Provisional Battalion), to be Quartermaster, with the honorary rank of Lieutenant, dated March 14, 1916.

Lieutenant (on probation) Francis H. Goss, M.B., is confirmed in his rank.

Lieutenant (on probation) William L. A. Harrison is confirmed in his rank.

Lieutenant (on probation) Claud A. Slaughter is confirmed in his rank, dated March 24, 1916.

Temporary Lieutenant Ian Finlayson Mackenzie, from the Royal Army Medical Corps, to be Lieutenant, dated February 26, 1916.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF JANUARY, FEBRUARY AND MARCH, 1916.

Title of Work and Author	Edition	Date	How obtained
Practical Organic and Bio-Chemistry. By R. H. A. Plimmer		1915	Library Grant.
Principles of Physiology. By E. H. Starling, M.D., F.R.S.	2nd	1915	,, ,,
Quantitative Laws in Biological Chemistry. By S. Arrhenius, M.D., F.R.S.		1915	,, ,,
The Principles of Hygiene. By D. H. Bergey, M.D.	5th	1914	,, ,,
Medical Chemistry and Toxicology. By James W. Holland, M.D.		1915	,, ,,
Tropical Medicine and Hygiene. By C. W. Daniels, Part 2	2nd	1915	,, ,,
Bedside Hæmatology. By Gordon R. Ward ..		1914	,, ,,
The House Fly, its Structure, Habits, &c. By C. Gordon Hewitt		1914	,, ,,
Diarrhœa, Inflammatory and Parasitic Diseases of the Intestines. By S. G. Gant, M.D.		1915 1915	,, ,, ,, ,,
Pathological Technique. By Mallory and Wright	6th	1915	,, ,,
A Text-book of Pathology. By Stengel and Fox ..	6th	1915	,, ,,
Pathology, General and Special. By R. T. Hewlett	3rd	1912	,, ,,
Buchanan's Anatomy, Systematic and Practical ..	3rd	1916	,, ,,
Manual of Surgery. By Thornton and Miles ..	5th	1915	,, ,,
Surgery of the Head. By Major L. Bathe Rawling		1915	,, ,,
Wounds in War. By Lieut.-Colonel D'Arcy Power		1915	,, ,,
Abdominal Injuries. By Morrison and Richardson		1915	,, ,,
Wounds of the Thorax in War. By J. Keogh Murphy		1915	,, ,,
Gunshot Injuries of Bones. By E. W. Hey Groves		1915	,, ,,
Operative Gynæcology. By H. S. Crossen		1915	,, ,,
A Text-book of Surgery. By R. Warren, M.D. ..		1915	,, ,,
A Treatise on Tumours. By A. E. Hertzler, M.D.		1912	,, ,,
The X-ray in the Diagnosis of Diseases of the Chest. By Walsham and Orton		1906	,, ,,
Practical Medical Electricity and Radiography. By A. C. Norman			,, ,,
A System of Operative Surgery. By F. F. Burghard. Vols. i, ii and iii.	2nd	1914	,, ,,
The Operations of Aural Surgery. By West and Scott		1909	,, ,,
A Practical Handbook of Surgical After-treatment. By A. H. Todd		1915	,, ,,
A Text-book on Ophthalmology. By Dr. A. E. Fuchs	4th	1913	,, ,,
Squint: Its Causes, Pathology and Treatment. By C. Worth	4th	1915	,, ,,
Ophthalmic Therapeutics. By Dr. A. Darier. Translated by S. Stevenson		1911	,, ,,
Pathology and Bacteriology of the Eye. By Collins and Mayou		1911	,, ,,
Ophthalmic Semiology and Diagnosis. By C. H. Beard, M.D.		1913	,, ,,
Diseases of the Arteries. By Sir Clifford Allbutt, K.C.B.		1915	,, ,,
Principles of General Physiology. By W. M. Bayliss, F.R.S.		1915	,, ,,
Common Disorders and Diseases of Childhood. By G. F. Still, M.A., M.D.	3rd	1915	,, ,,

List of Books added to the Library—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Anæsthesia. By Gwathmey and Baskerville ..		1914	Library Grant.
The Heart in Early Life. By G. A. Sutherland, M.D.		1914	,, ,,
Technical Gas Analysis. By G. Lunge		1914	,, ,,
Diseases of the Nose, Throat and Ear. By E. B. Gleason, M.D.	3rd	1915	,, ,,
Diseases of the Nose and Throat. By D. B. Kyle	5th	1915	,, ,,
A Practical Manual of Bandaging. By D. C. L. Fitzwilliam		1915	,, ,,
The Book of Pharmacopœias and Unofficial Formularies. By Lucas and Stevens			
An Introduction to the Study of Colour Vision. By J. H. Parsons		1915	,, ,,
Urinary Analysis and Diagnosis. By L. Heitzmann	3rd	1915	,, ,,
Handbook of Diseases of the Eye. By Swanzy and Werner	11th	1915	,, ,,
Chlorine and Chlorine Products. By G. Martin ..		1915	,, ,,
Diseases of Children. By Goodhart and Still ..	10th	1915	,, ,,
Radium, X-rays and the Living Cell. By Colwell and Russ		1915	,, ,,
Principles and Practice of Obstetrics. By J. B. De Lee, M.D.	2nd	1915	,, ,,
Alveolo-dental Pyorrhœa. By Bass and Jones ..		1915	,, ,,
The Difficulties and Emergencies of Obstetric Practice. By Berkeley and Bonney	2nd	1915	,, ,,
Diseases of Women. By Herman and Maxwell ..		1913	,, ,,
A Text-book of Bactericology. By Hiss and Zinsser	2nd	1915	,, ,,
Prescribers' Formulary and Index of Pharmacy. By T. P. Beddoes	2nd	1915	,, ,,
Post-mortem Methods. By J. M. Beattie		1915	,, ,,
A Treatise on the Diseases of Women. By P. Findley			
Injuries to Joints. By Major R. Jones		1915	,, ,,
Injuries of the Eyes, Nose, Throat and Ears. By Ramsay, Grant, and others		1915	,, ,,
The Operative Treatment of Chronic Intestinal Stasis. By Sir W. Arbuthnot Lane	3rd	1915	,, ,,
The Tonsils: Faucial, Lingual, and Pharyngeal. By H. A. Barnes, M.D.		1914	,, ,,
Operative Surgery of the Nose, Throat and Ear. By H. W. Loeb. Vol. i		1914	,, ,,
Indispensable Orthopædics. By Calot and Robinson	6th	1914	,, ,,
Surgery of the Blood-vessels. By J. S. Horsley, M.D.		1915	,, ,,
Amœbiasis and the Dysenterics. By L. P. Phillips, M.D.		1915	,, ,,
Water Supplies. By S. and E. K. Rideal		1914	,, ,,
The Operations of Surgery (Jacobson). By Rowlands and Turner	6th	1915	,, ,,
The Selection of the Recruit. By Captain S. T. Biggs, M.D.		1915	,, ,,
La Vaccination Anti-typhoïdique. Par le Dr. H. Méry		1915	,, ,,
Notes on Dental Surgery and Pathology. By T. W. Widdowson		1914	,, ,,
A Text-book of Diseases of the Nose, Throat and Ear. By Wright and Smith		1915	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Borderline Diseases. By J. N. Hall..		1915	Library Grant.
Medical Lectures and Clinical Aphorisms. By S. Gee	4th	1915	,, ,,
Diseases of the Kidney, Ureter and Bladder. By Kelly and Burnham		1914	,, ,,
Diagnostic and Therapeutic Technic. By A. S. Morrow, M.D.	2nd	1915	,, ,,
Medical Hints for the Use of Medical Officers temporarily employed with the Troops. By J. E. Squire		1915	,, ,,
Œdema and Nephritis. By M. H. Fischer ..	2nd	1915	,, ,,
Clinical Diagnosis, a Manual of Laboratory Methods. By J. C. Todd, M.D.		1914	,, ,,
Early Diagnosis of Heart Failure. By. T. S. Willson		1915	,, ,,
Salvarsan Treatment of Syphilis. By Taylor and McKenna		1914	,, ,,
The Treatment of Tuberculosis and Lupus. By W. C. Minchin	2nd	1915	,, ,,
Alcohol and the Human Body. By Horsley and Sturge	5th	1915	,, ,,
The Prevention of Dental Caries and Oral Sepsis. By H. C. Picknill	2nd	1914	,, ,,
Practical Sanitation. By Simonds and Gardner ..		1914	,, ,,
Insects and Man. By C. A. Ealand		1915	,, ,,
Defective Children. By T. N. Kelynack		1915	,, ,,
Diet and Disease in Infancy. By G. H. C. Cameron, M.D.		1915	,, ,,
A Report on Researches on Sprue in Ceylon. By P. H. Bahr		1914	,, ,,
Applied Immunology. By Thomas and Ivey ..		1915	,, ,,
Practical Text-book of Infection, Immunity, and Specific Therapy. By John A. Kolmer		1915	,, ,,
Infection and Resistance. By H. Zinsser		1914	,, ,,
Bodily Changes in Pain, Hunger, Fear, and Rage. By W. B. Cannon		1915	,, ,,
The Origin and Nature of the Emotions. By G. W. Crile		1915	,, ,,
Diseases of the Nervous System. By H. C. Thompson		1915	,, ,,
Chemistry Inorganic and Organic. By A. G. Bloxam		1913	,, ,,
Manual of Pharmacology. By W. E. Dixon ..	4th	1915	,, ,,
Physico-chemical Tables. By John Castell-Evans		1902-11	,, ,,
Spon's Workshop Receipts		1909	,, ,,
Solubilities of Inorganic and Organic Substances. By A. Seidell		1911	,, ,,
Hints on Outfit for Travellers in the Tropics. By C. F. Harford		1911	,, ,,
Lessons in Elementary Tropical Hygiene. By H. Strachan		1914	,, ,,
Diseases of the Heart. By James Mackenzie ..	3rd	1914	,, ,,
A System of Medicine. Edited by Osler and McCrae. 5 vols.			
Tropical Hygiene for Residents in Tropical and Sub-Tropical Climates. By Lukis and Blackham	3rd	1915	,, ,,
Ticks: A Monograph of the Ixodoidia. Parts 2 and 3. By Professor G. H. F. Nuttall and others		1911-15	,, ,,
The Treatment of Fractures by Mobilisation and Massage. By James B. Mennell, M.D.		1911	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Notes on Military Orthopædics. By Paul Bernard Roth		1916	Library Grant.
A Manual of Surgical Treatment. By Cheyne and Burghard. Vol. v		1913	,, ,,
Quain's Elements of Anatomy. Vol. iv. Part i ..	11th	1915	,, ,,
Wound Infections. By Sir A. E. Wright		1915	,, ,,
A Complete Handbook for the Hospital Corps of the U.S. Army and Navy. By C. F. Mason		1914	,, ,,
Cunningham's Text-book of Anatomy. Edited by A. Robinson, M.D.	4th	1915	,, ,,
War Diseases. Reprinted from *The Practitioner* ..		1914	,, ,,
Character and Intelligence. By Edward Webb ..		1915	,, ,,
A Guide to the Use of Tuberculin. By Cochrane and Sprawson		1915	,, ,,
Pharmaceutical Formulas. By Peter MacEwan ..	9th	1914	,, ,,
Therapeutics of the Circulation. By Sir T. Lauder Brunton	2nd	1915	,, ,,
With the Army in Flanders. By G. V. Williams		1915	,, ,,
War Pictures behind the Lines. By Ian Malcolm, M.P.	2nd	1915	,, ,,
A Surgeon in Khaki. By A. A. Martin, M.D. ..		1915	,, ,,
A Surgeon in Belgium. By H. S. Souttar		1915	,, ,,
Antiquity of Man. By A. Keith, M.A., F.R.S. ..		1915	,, ,,
Jungle Days. By A. Munson, M.D.		1914	,, ,,
Through Siberia, the Land of the Future. By F. Nansen		1914	,, ,,
Evolution and the War. By P. C. Mitchell ..		1915	,, ,,
The Poison War. By A. A. Roberts		1915	,, ,,
With the Turkish Army in the Crimea and Asia Minor. By Thomas Buzzard, M.D.		1915	,, ,,
Physiology of the Semicircular Canals and their Relation to Sea-sickness. By Joseph Byrne, A.M., M.D. .		1915 1912	Editor, Journal. ,, ,,
Systematic Case-taking. By H. L. McKisack, M.D.		1912	,, ,,
Amœbic or Tropical Dysentery. By W. C. Brown, M.D.		1910	,, ,,
The Tuberculosis Year Book and Sanatoria Annual. Edited by T. N. Kelynack, M.D. Vol. i		1913-14	,, ,,
Phases of Evolution and Heredity. By D. Berry Hart, M.D.		1910	,, ,,
The Influence of Strong Rain-bearing Winds on the Prevalence of Phthisis. By W. Gordon, M.A., M.D.		1910	,, ,,
X-rays: An Introduction to the Study of Röntgen Rays. By C. W. C. Kaye, B.A., B.Sc.		1914	,, ,,
Insomnia: Its Causes and Treatment. By Sir James Sawyer, M.D.	2nd	1912	,, ,,
The Treatment, Prevention and Cure of Tuberculosis and Lupus with Allyl Sulphide. By W. C. Minchin, M.D.		1912	,, ,,
Lectures on Biology. By Dr. Curt Thesing. Translated by W. R. Boelter		1910	,, ,,
Sea-sickness and Health. By Joseph Byrne, A.M., M.D.		1912	,, ,,
Remedial Gymnastics for Heart Affections used at Bad-Nauheim. By J. G. Garson, M.D.		1909	,, ,,
The Tobacco Habit, its History and Pathology. By H. H. Tidswell		1912	,, ,,

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
Materia Medica and Therapeutics. By Bance and Dilling	9th	1912	Editor, Journal.
Clinical Methods. By Hutchison and Rainy ..	5th	1912	,, ,,
A Surgical Treatment of Locomotor Ataxia. By L. N. Denslow, M.D.		1912	,, ,,
On Conjugal Happiness. By Dr. L. Lowenfeld. Translated by R. E. S. Krohn, M.D.		1912	,, ,,
St. Thomas's Hospital Reports. New Series. Vol. xlii		1915	,, ,,
Report of the Surgeon-General U.S. Army to the Secretary of War		1915	,, ,,
A Manual of Surgical Anæsthesia. By H. Bellamy Gardner	2nd	1916	,, ,,
Syphilology and Venereal Disease. By C. F. Marshall, M.D.	3rd	1914	,, ,,
The Biology and Treatment of Venereal Diseases. By J. E. R. McDonagh		1915	,, ,,
Exercise in Education and Medicine. By R. Tait McKenzie, M.D.	2nd	1915	,, ,,
Third Report of the Yellow Fever Commission, West Africa		1915	,, ,,
Commonwealth of Australia. Quarantine Service. Service Publication No. 6. Australia and Yellow Fever		1915	,, ,,
Proceedings of the Medical Association of the Isthmian Canal Zone, for the Half-year, April, 1914, to October, 1914		1916	,, ,,
44th Annual Report of the Local Government Board. Supplement containing the Report of the Medical Officer, 1914-15		1916	Commandant's Office.
Memorandum on the Treatment of Injuries in War		1915	Commandant's Office.
Experiences in Serbia, 1914-15. By Lieut.-Colonel J. T. J. Morrison, R.A.M.C. (T). Reprinted from the *Lancet*, November 6, 1915)		1915	Director-General, A.M.S.
Index Catalogue of the Library of the Surgeon-General's Office, United States Army. Second Series. Vol. xx		1915	Surgeon-General, U.S. Army.
13th and 14th Annual Reports of the Institute of Medical Research, Kuala Lumpur, Federated Malay States		1913-14	Surgeon-General Sir D. Bruce, C.B., F.R.S.
Report on a Mosquito Survey of Colombo. By James, Da Silva and Arndt		1914	Surgeon-General, Sir D. Bruce, C.B., F.R.S.
Nigeria Medical Research Institute, Annual Report, 1914		1916	Crown Agents for the Colonies.
Annual Report of the London County Council, 1914. Vol. iii. Public Health		1916	Clerk of the Council.
Report of the Accra Laboratory for the Year 1914. By J. W. Scott MacFie, M.A., D.Sc.		1915	Crown Agents for the Colonies.
The Geographical Journal. Vols. xliv, xlv, xlvi, xlvii. Numbers 1 and 2			Presented by Colonel R. J. S. Simpson, C.M.G.
Journal of the Royal Naval Medical Service. Vol. ii. No. 1		1916	Presented by the Editor.
Surgery in War. By Major A. J. Hull, R.A.M.C. With a Preface by Sir A. Keogh, K.C.B., M.D.		1916	Presented by the Publishers.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

Cash Statement.

Dr.

Receipts.

Date		£	s.	d.
1914 Mar. 1.	To Balance of Cash brought forward from 1913-1914	380	4	2
	,, Subscriptions	480	1	9
	,, Balance of Mess Funds given by members of the late R.A.M.C. Mess, Roberts's Heights, Transvaal	138	11	2
	,, Sierra Leone Entertainment Committee, Cash balance, for custody	14	14	1
		£1,013	11	2

Cr.

Payments.

Date		£	s.	d.	£	s.	d.
1914	By Curragh Mess, grant for furniture, &c.				100	0	0
	,, Bangalore Mess, Grant				50	0	0
	,, Scottish Command, Purchase of Camp Canteen				40	0	0
	,, Subscribers joining Contributions to Messes				24	13	2
	,, Thos. Cook and Son, Freight of Mess Plate from Roberts's Heights, Transvaal				6	10	9
	,, Distribution of Tempe Mess Plate to various Messes				2	4	2
	,, Paymaster, Cape Town, on behalf of Roberts's Heights Mess				1	1	0
	,, Audit Fee				3	3	0
	,, Printing, Typing, &c.	3	2	9			
	,, Postage	2	7	9			
	,, Stationery	0	13	3			
	,, Reporter's Fee, Annual Meeting, 1914	1	1	0			
	,, Copies of Corps News	0	3	2			
					7	7	11
	,, J. S. Levack, Esq., refund of Subscription overpaid				0	7	0
	,, Transferred to Deposit Account				200	0	0
1915 Feb. 28.	Balance of Cash forward to 1915-16				578	4	2
					£1,013	11	2

Balance Sheet at February 28, 1915.

Liabilities.

	£	s.	d.
Balance	838	4	2
	£838	4	2

Assets.

	£	s.	d.
Balance outstanding of Loan to Aldershot	60	0	0
Cash on deposit with Messrs. Holt and Co.	200	0	0
Cash at Bankers	578	4	2
	£838	4	2

Audited and found correct,
(Signed) EDMOND T. GANN.

December 29, 1915.

(Signed) J. T. CLAPHAM, *Captain,*
Hon. Secretary.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

Agenda for a Committee Meeting to be held on Wednesday, April 12, 1916, at 3 p.m., at the War Office, in Room 357.

(1) To confirm the Minutes of the last meeting.
(2) To consider the application for grants for the current year, and recommend the same to the Annual General Meeting.
(3) To consider the investment of any surplus funds after the above grants have been made under Rule 10.
(4) To note that the Annual General Meeting will be held at 3 p.m. on June 12, in the Library of the Royal Army Medical College.
(5) To consider any other business that may be brought before the Meeting.

F. W. H. Davie Harris, *Lieutenant-Colonel,*
Secretary.

List of Applicants for 1916.	*Previous Grants*
Three orphans of the late Staff-Surgeon D. O. D.	£30
Orphan of Surgeon-Major C. Q.	30
Orphan of Inspector-General D. A.	30
Orphan of Surgeon-General A. S.	20
Orphan of Lieutenant-Colonel H. C.	25
Orphan of Surgeon-General J. O.	40
Orphan of Dep. Surgeon-General W. F. I.	40
Orphan of Surgeon-General T. B.	40
Orphan of Surgeon-Major B. C. S...	30
Orphan of Major P. G. I.	40
Three orphans of Captain G. C.	40
Orphan of Surgeon-General R. A. C.	25
Orphan of Surgeon-General J. W. M.	20
Orphan of Staff-Surgeon J. W. C.	20
Orphan of Surgeon-General J. F.	30
Orphan of Surgeon-General W. T. H.	20
Two orphans of Lieutenant-Colonel H. J. P.	10
Eight orphans of Lieutenant-Colonel J. W.	40
Orphan of Lieutenant-Colonel H. P. J. E.	10
Orphan of Captain T. S.	10
Two orphans of Captain R. D. O'C.	20
Orphan of Lieutenant-Colonel R. G. H.	*Nil*
Three orphans of Lieutenant-Colonel T. McC.	*Nil*
Orphan of Surgeon-General Major W. P. F.	*Nil*

Notice of the Annual General Meeting.

The Annual General Meeting of subscribers to this Society will be held in the Library of the Royal Army Medical College, Grosvenor Road, S.W., at 3 p.m., on Monday, June 12, 1916.

The Director-General will preside.

It is hoped that all officers will freely express their views on any point connected with the Society. Those officers who may wish for information on any special point are requested to communicate with the Secretary, so that the necessary information may be furnished in response to any question asked.

F. W. H. Davie Harris,
Lieutenant-Colonel,
Secretary.

124, *Victoria Street, S.W.*

BENEVOLENT SOCIETIES FOR THE BENEFIT OF THE FAMILIES OF OFFICERS AND OTHER RANKS OF THE MEDICAL SERVICES.

It has been suggested that Benevolent Societies be formed for the benefit of the families of officers and other ranks of the Medical Services auxiliary to the Regular Royal Army Medical Corps, viz., the Special Reserve, the Territorial Force and New Army.

Funds would be raised by voluntary subscriptions, and it has been proposed that each branch of the Service should appoint a committee of five to seven members to administer its own funds.

A meeting presided over by the Director-General will be held in the Lecture Theatre of the Royal Army Medical College, Grosvenor Road, S.W., on Wednesday, May 10, 1916, at 3 p.m., and it is hoped that as many officers as possible will attend.

In the meantime any inquiries may be referred to Lieutenant-Colonel G. St. C. Thom, R.A.M.C., War Office, S.W.

ROYAL ARMY MEDICAL CORPS FUND.

NOTICE OF THE ANNUAL GENERAL MEETING.

The Annual General Meeting of subscribers to this Fund will be held in the Library of the Royal Army Medical College, Grosvenor Road, S.W., at 2.30 p.m., on Monday, June 12, 1916.

The Director-General will preside. It is hoped that all officers will freely express their views on any point connected with the Fund. Those officers who may wish for information on any special point are requested to communicate with the Secretary, so that the necessary information may be furnished in response to any question asked.

F. W. H. DAVIE HARRIS,
Lieutenant-Colonel,
Secretary.

124, *Victoria Street, S.W.*

EASTER GREETINGS TO RUSSIAN ARMY.

To foster comradeship and mutual good feeling between the Medical Services of the two Armies Easter Greetings were sent early this month to the medical officers of the Russian Army.

The Greetings took the form of cards and were accompanied by a letter from Sir Alfred Keogh to the Director-General of the Russian Army.

The cards were double and were similar to those in ordinary use at Christmas time in this country. On the front page the Corps Crest was reproduced in gold and silver and, crossed below, the British and Russian National Flags in colours. On an inner page the following was inscribed :—

"The Director-General and the Officers of the Medical Services of the British Army send hearty greetings to their Comrades in the Medical Services of the Russian Army.

"Easter, 1916."

The card was held together by a knot of ribbon of the Corps colours.

LETTER FROM THE DIRECTOR-GENERAL.

TO THE PRINCIPAL ARMY MEDICAL INSPECTOR, IMPERIAL RUSSIAN ARMY.

DEAR SIR,—The Officers of the Royal Army Medical Corps of the British Army have expressed a wish to send their heartiest Easter Greetings to their comrades of the Russian Army Medical Service, and they have requested me to convey to them through you their expressions of esteem and admiration of the work which they have so nobly carried out during the progress of the War.

As a small mark of the deep sympathy between the two Medical Services, we are sending you to-day some Easter cards for transmission to the hospitals and other

units under your control. Would you be pleased to have them distributed wherever you may consider this slight testimony of our friendship may be most appreciated. We congratulate you and your officers on your noble achievements in the cause of humanity, and your successful efforts to allay suffering and assist the splendid Russian Army to attain the glorious peace we all so devoutly desire.

Please accept our good wishes for the future, and be assured that we shall watch with pride the future progress of our professional brothers in the service of our gallant Allies.

Believe me to be,
Yours very faithfully,
(*Signed*) ALFRED KEOGH,
Director-General.

MARRIAGE.

MENZIES—BOYES.—At St. Mary Abbott's, Kensington, on February 29, by the Rev. A. E. Morris, M.A.; Captain Arthur John Alexander Menzies, D.S.O., R.A.M.C., son of the late Alexander Menzies, Lankat Estate, Sumatra, and of Mrs. Stephens, 30, Murrayfield Road, Edinburgh, to Ethel Fanny Whitelock, younger daughter of the late Rev. D. L. Boyes, Melrose, and of Mrs. Boyes, 3, Downie Terrace, Murrayfield, Midlothian.

DEATHS.

GIBBON.—Surgeon-Major (Honorary Brigade Surgeon) Edward Acton Gibbon, Army Medical Service (retired), died at Sleedagh, Wexford, on February 15, 1916.

DUNCAN.—Captain Ronald Wingrave Duncan (Special Reserve), killed at Basra March 8, 1916.

GRANT.—Surgeon-Major (Honorary Brigade Surgeon) Robert Alexander Peter Grant, Army Medical Service (retired), died at Reay House, Inverness, on March 8, 1916.

LANDALE.—Deputy Surgeon-General James Landale, M.D., died at The Park, Dunholme, on March 8, 1916.

FERGUSON.—Colonel Richard Patrick Ferguson, Army Medical Service (retired), died on March 10, 1916.

BALL.—Temporary Lieutenant-Colonel Sir Charles Bent Ball, Bt., M.D., F.R.C.S.I., died at 24, Merrion Square, Dublin, on March 17, 1916.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

· Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts *	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2				
	8	0 5 0	0 2 3	4 3	1 1	3 10	0 9
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5				
	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10				
	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1				
	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5				
	8	0 15 0	0 6 7	10 10	7 6	9 0	4 10
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 1s. 8d. net; binding, 1s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from H. Warren Crowe, Esq., Lieutenant-Colonel G. J. S. Archer, Major G. Dreyer, Captain E. D. Telford, Captain D. Thomson, Captain R. G. Archibald, Captain H. S. Blackmore, Lieutenant H. H. Sampson, Lieutenant J. Gordon Thomson, F. W. Foreman, Esq., G. S. Graham-Smith, Esq., Grace Briscoe, G. L. Preston, Esq., Serjeant Charles J. Fernbank.

The following publications have been received:—

British: Tropical Veterinary Bulletin, The Practitioner, Medical Press and Circular, The Lancet, Journal of the Royal Sanitary Institute, The Royal Engineers' Journal, The Hospital, Journal of the Royal United Service Institution, The Indian Medical Gazette, Medical Journal of Australia, Guy's Hospital Gazette, The Army Service Corps Journal, The Journal of State Medicine, The Indian Journal of Medical Research, Tropical Diseases Bureau, Proceedings of the Royal Society of Medicine, Public Health, The Australian Military Journal, The Journal of Tropical Medicine and Hygiene, The Medical Journal of South Africa.

Foreign: Bulletin de la Société de Pathologie Exotique, Revista de Sanidád Militar, United States Public Health Service, Bulletin de l'Institut Pasteur, Archives de Médecine et de Pharmacie Militaires, International Military Digest Quarterly, Le Caducée, The Military Surgeon, Office International d'Hygiène Publique.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

MAY, 1916.

EXTRACT FROM THE "LONDON GAZETTE," APRIL 4-5, 1916.

War Office,
April 5, 1916.

The following despatch from General Sir John Nixon, K.C.B., relative to the operations in Mesopotamia from the middle of April to the end of September, 1915, has been forwarded by the Government of India for publication :—

General Headquarters, I.E.F. "D."
January 1, 1916.

From General Sir John Nixon, K.C.B., A.D.C., General, Commanding Indian Expeditionary Force "D."

OPERATIONS, KHAFAJIYAH, APRIL 24 TO JUNE 19, 1915.

Medical Services.

Major H. R. Brown, I.M.S.
Lieutenant-Colonel H. O. B. Browne-Mason, R.A.M.C.
Lieutenant-Colonel J. F. Donegan, R.A.M.C.
Colonel P. Hehir, I.M.S.
Lieutenant R. V. Martin, I.M.S.
Captain G. Wilson, R.A.M.C.
3rd Class Assistant Surgeon E. A. Cotton.
2nd Class Assistant Surgeon E. S. Shede.
No. 7558 Corporal W. J. Sanger, Dorsetshire Regiment.
No. 7321 Private W. Jolly, Norfolk Regiment.
No. 1835 Colour Havildar Shaikh Haidar, 103rd Mahratta L.I.

Army Bearer Corps.

No. 9402 Bearer Balu.
No. 1578 Bearer Ghowr.
No. 1436 Bearer Umar Din.
No. 1582 Bearer Balore.

EUPHRATES OPERATIONS, JUNE 26 TO JULY 25, 1915.

Medical Services.

Colonel H. M. Adamson, R.A.M.C.
Captain P. B. Bharucha, I.M.S., F.R.C.S.
Captain R. C. Clifford, I.M.S.
Captain R. E. Flowerdew, I.M.S.

Lieutenant-Colonel E. Jennings, I.M.S.
Captain F. A. Robinson, R.A.M.C.
Major A. Spitteler, I.M.S.
No. 854 1st Class Sub-Assistant Surgeon Mohan Lal.
No. 1080 1st Class Sub-Assistant Surgeon Barkatullah.
No. 316 3rd Class Sub-Assistant Surgeon Fazl Ahmad.
No. 1301 Ward Orderly Rahla Singh, 76th Punjabis.

OPERATIONS, KUT-AL-AMARA, SEPTEMBER 28, 1915.

General Headquarters Staff, etc.

Surgeon-General H. G. Hathaway, C.B.

Medical Services.

Major S. Anderson, I.M.S.
Lieutenant-Colonel J. F. Donegan, R.A.M.C.
Major F. C. Lambert, R.A.M.C.
Captain K. K. Mukerji, I.M.S.
Lieutenant F. T. Simpson, R.A.M.C.
Captain J. Startin, R.A.M.C.
1st Class Assistant Surgeon Amba Shankar Morarji.
4th Class Assistant Surgeon H. J. Luxa, I.S.M.D.
4th Class Assistant Surgeon S. A de Souza, I.S.M.D.
No. 1032 1st Class Sub-Assistant Surgeon Mitthy Lal.
No. 1343 1st Class Sub-Assistant Surgeon Samuel Manikkam.

Army Bearer Corps.

No. 2380 Havildar Lal Din.
No. 5049 Naik Noondi.
No. 1495 Lance-Naik Sher Ahmed.
No. 1013 Bearer Devi Din.

Army Hospital Corps.

No. 252 Pukali Bhisti Amboo Succaram.
No. 184 Bhisti Hussain Bapoo.

WAR OFFICE,
April 5, 1916.

THE Government of India has forwarded for publication in the *London Gazette* the undermentioned list of officers and men whose names have been mentioned in despatches from the General Officer Commanding for services in connection with the operations in Mesopotamia from November 6, 1914, up to April 14, 1915.

(These despatches have already been published as a Parliamentary Blue Book: Command Paper No. 8074 of 1915.)

STAFF.

Colonel P. H. Hehir, M.D., I.M.S.

ROYAL ARMY MEDICAL CORPS.

Lieutenant-Colonel J. Hennessey.
Lieutenant Colonel F. J. Palmer.
Lieutenant-Colonel H. M. Adamson.
Lieutenant-Colonel F. J. Donegan.
Lieutenant-Colonel H. O. B. Browne-Mason.
Lieutenant-Colonel D. J. Collins.
Major E. Bennett.
Major H. A. Bransbury.
Major J. C. Foster.
Major F. C. Lambert.
Captain A. T. J. McCreery.
Lieutenant E. B. Allnutt.
Lieutenant M. Burnett.

INDIAN MEDICAL SERVICE.

Lieutenant-Colonel G. B. Irvine.
Major J. H. Horton.
Major D. S. A. O'Keefe.

Major H. R. Brown.
Major L. Cook.
Captain R. E. Wright.
Captain J. H. Hislop.
Captain D. Arthur.
Captain C. H. Barber.
Captain H. E. Shortt.
Captain C. C. C. Shaw.
Captain G. F. Graham.
Captain R. Knowles.
Captain J. J. Harper Nelson.
Captain F. C. Fraser.
Captain H. E. Stanger Leathes.
Lieutenant Narayan Krishna Bal.
Lieutenant L. A. P. Anderson.

INDIAN SUBORDINATE MEDICAL DEPARTMENT.

1st Class Assistant-Surgeon W. H. Brown.
3rd Class Assistant-Surgeon J. H. S. Huffton.
3rd Class Assistant-Surgeon E. A. Cotton.
3rd Class Assistant-Surgeon L. C. Raphael.
3rd Class Assistant-Surgeon H. Vincent.
3rd Class Assistant-Surgeon J. V. Fernandez.
4th Class Assistant-Surgeon J. H. T. Pacheco.
4th Class Assistant-Surgeon H. N. Murphy.
4th Class Assistant-Surgeon A. E. Phaure.
No. 282 1st Class Sub-Assistant-Surgeon Vroj Lal Umed Ram Pandit.
No. 854 1st Class Sub-Assistant-Surgeon Mohan Lal.
No. 211 1st Class Sub-Assistant-Surgeon Ganga Ram Hariba.
No. 1338 1st Class Sub-Assistant-Surgeon V. Sambasiva Nayakar.
No. 210 1st Class Sub-Assistant-Surgeon Nunasami Ramasami.
No. 972 1st Class Sub-Assistant-Surgeon Sundar Singh.
No. 318 2nd Class Sub-Assistant-Surgeon Shaik Azimud-din Shaikh Ismail.
No. 426 3rd Class Sub-Assistant-Surgeon Keshav Waman Khuperkar.
No. 402 3rd Class Sub-Assistant-Surgeon Shaikh Muhammad Dadasahib.

HOSPITAL STOREKEEPERS.

Serjeant J. A. Bloomfield, G.I.P., Ry. Volunteers.
Private Moos, Poona Volunteer Rifles.
2nd Class Hospital Storekeeper, B. F. Ghyara, S. and T. Corps.

ARMY BEARER CORPS.

No. 9339 Bearer Samedin.
No. 4485 Bearer Subhan Singh.
No. 7480 Bearer Gariba Singh.
No. 9344 Bearer Dhonde.
No. 1196 Bearer Ramcharan.
No. 7485 Bearer Rafawa.

ARMY HOSPITAL CORPS.

No. 6147 2nd Grade Ward Servant Abba Pira.
No. 5308 1st Grade Ward Sweeper Mohan Singh.
No. 5207 1st Grade Ward Water Carrier Bhondoo.
No. 263 Bhisti Raja Piussal, S. and T. Corps.
No. 6352 3rd Grade Ward Servant Ganga Ram Gainu.
No 6428 2nd Grade Ward Sweeper Mohan Nathu.
No. 6032 1st Grade Water Carrier Gainoc Baloo.
No. 266 Bhisti Shaikh Amur.

ARMY MEDICAL SERVICE.

Hugh Mallinson Rigby, M.B., F.R.C.S., to be temporary Colonel, dated April 12, 1916.

ROYAL ARMY MEDICAL CORPS.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst commanding Casualty Clearing Stations :—

Dated October 26, 1915.—William D. C. Kelly, M.B.

Dated January 22, 1916.—Daniel L. Harding, D.S.O., F.R.C.S.I.

Dated April 12, 1916.—Temporary Major William T. Prout, C.M.G., M.B.

Dated April 9, 1916.—Temporary Major Alfred Lingard, M.B.

Harry Butson Maunsell to be temporary Captain, dated September 12, 1915. (Substituted for the notification which appeared in the *Gazette* of November 5, 1915.)

Thomas Monck Burn-Murdoch, M.B., F.R.C.P.Edin., to be temporary Hon. Major whilst employed at the Smithston War Hospital, Greenock, dated February 19, 1916.

Captain William R. O'Farrell is restored to the establishment, dated March 5, 1916.

Temporary Captain John C. Webb, M.B., to be temporary Major, dated April 26, 1916.

The undermentioned to be temporary Captains :—

Dated February 10, 1916.—Captain Donald James McLaren, M.B., from Somerset Light Infantry (Territorial Force).

Dated March 25, 1916.—Robert Lloyd Roe, M.B.; Henry Charles Semon, M.D., from Indian Medical Service.

Dated April 8, 1916.—Temporary Lieutenant Ernest S. Moorhead, M.B.

Lieutenant (temporary Captain) Andrew John Metford Wright, M.B., F.R.C.S., from Royal Engineers (Territorial Force), dated April 12, 1916.

Captain John W. Lane, M.D., to be temporary Major whilst commanding a Field Ambulance, dated April 11, 1916.

The appointment as temporary Lieutenant of Arthur F. Cole is antedated to June 28, 1915.

The undermentioned are granted temporary rank whilst employed at the Northamptonshire War Hospital :—

As Lieutenant-Colonel: Dated February 9, 1916.—William Harding, M.D. As Major: Frederick Joshua Stuart.

Alfred Dorriforth Vardon, late Captain Banffs Artillery Volunteers, to be temporary Captain, dated October 1, 1915. (Substituted for the notification which appeared in the *Gazette* of October 23, 1915.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst commanding Casualty Clearing Stations :—

Dated October 14, 1915.—Richard F. Ellery.

Dated February 13 to 19, 1916.—Robert J. Cahill, M.B.

The undermentioned are granted temporary rank whilst commanding Field Ambulances :—

As Lieutenant-Colonel: Dated February 28, 1916.—Major William M. B. Sparkes. Dated March 3, 1916.—Major John G. Bell, M.B. As Major: Dated December 1, 1915. —Captain William E. Marshall, M.B.

The undermentioned are granted temporary rank whilst commanding Field Ambulances :—

As Lieutenants-Colonel: Dated September 4, 1914.—Brevet Lieutenant-Colonel FitzGerald G. Fitzgerald.

Major Basil F. Wingate, dated May 4, 1915.

Major Montague F. Grant, M.D., dated January 8, 1916.

Major George A. K. H. Reed, from January 13 to March 11, 1916.

Major George H. Richard, dated January 28, 1916.

Major John Fairbairn, M.B., dated January 30, 1916

As Major: Captain Vincent T. Carruthers, M.B., F.R.C.S.Edin., from December 6 to December 13, 1915.

Major (temporary Lieutenant-Colonel) P. A. Lloyd-Jones, D.S.O., relinquishes his temporary rank on re-posting, dated December 16, 1915.

Harold Chaffer, F.R.C.S., to be temporary Honorary Major whilst employed at the Red Cross Hospital, Bellahouston, dated April 5, 1916.

William Gemmell, M.B., F.R.C.S., to be temporary Honorary Captain whilst employed at the Red Cross Hospital, Bellahouston, dated April 5, 1916.

Leslie Stuart Kidd, to be temporary Honorary Captain whilst employed with the Australian Voluntary Hospital, dated March 17, 1916.

Major (temporary Lieutenant-Colonel) Charles Bramhall, relinquishes his temporary rank on re-posting, dated December 2, 1915.

Temporary Major E. W. H. Groves, M.D., F.R C.S. (Captain, Royal Army Medical Corps, Territoral Force), relinquishes his temporary commission, dated March 24, 1916.

Major (temporary Lieutenant-Colonel) Stanley E. Lewis, M.B., relinquishes his temporary rank on ceasing to command a Field Ambulance, dated March 7, 1916.

Temporary Captain Harry B. Maunsell relinquishes his commission, dated March 12, 1916.

Temporary Captain William P. Hogg, M.B., relinquishes his commission on appointment to the Indian Medical Service, dated March 13, 1916.

Major (temporary Lieutenant-Colonel) William M. B. Sparkes, relinquishes his temporary rank on vacating the appointment of Assistant Director of Medical Services of a Division, dated February 24, 1916.

Major (temporary Lieutenant-Colonel) Thomas S. Dudding relinquishes his temporary rank on ceasing to command a Field Ambulance, dated March 24, 1916.

The undermentioned to be temporary Lieutenants :—

Dated February 7, 1916.—George Everard Dodson.

Dated February 28, 1916.—Walter John May, M.B.

Dated March 4, 1916.—Gordon Burnham King.

Dated March 20, 1916.—John Norman Glaister; Wilfred Alan Curry, M.D., F.R.C.S. ; David Scott Taylor; Vivian Wallace.

Dated March 21, 1916.—William John Tulloch, M.D.

Dated March 22, 1916.—Charles Joseph McCarthy, M.B. ; Charles Cairnie, M.B.; William Ker Bell ; Charles Augustus Burpitt.

Dated March 23, 1916.—Charles Vivian Kebbell ; Robert Orr, M.B. ; Clive Menzies Fadie, M.B. ; David Rees ; William Francis Cornwall, M.B. ; John Tyldesley Bleasdell.

Dated March 24, 1916.—Adrian St. Johnston; George Robert Naylor, M.B.; Joseph Aloysius O'Dea, M.B. ; John Allan Chisholm Roy, M.B.

Dated March 27, 1916.—Trevor Gayer Fetherstonhaugh, M.B.; Rupert Stanley Novis.

Dated March 28, 1916.—Eric Edmund Chipp.

Dated April 9, 1916.—Claude R. Wright.

Dated April 14, 1916.—William Hugh Cowie Romanis, M.B., F.R.C.S.

The undermentioned temporary Lieutenants to be temporary Captains :—

Dated December 23, 1915.—Henry D. H. Willis-Bund.

Dated January 10, 1916.—Arthur Riley, M.B.

Dated February 1, 1916.—Harold A. Haig, M.B. ; Charles O'Brien, M.D.

Dated February 15, 1916.—Henry W. B. Danaher.

Dated February 20, 1916.—Hugh A. Beaver, M.B.

Dated February 25, 1916.—Thomas H. Agnew.

Dated February 28, 1916.—Arthur W. Matthew.

Dated March 1, 1916.—Wilfred Garten; Hugh T. L. Roberts.

Dated March 4, 1916.—Arthur M. Pryce, M.B.

Dated March 6, 1916.—Frank W. Wesley, M.D.

Dated March 8, 1916.—Horace F. Blood.

Dated March 9, 1916.—Arthur Bloom, M.D. ; George A. Birnie, M.B.

Dated March 10, 1916.—Walter C. C. Kirkwood, M.B.; John H. Wilkinson; John D. MacEwen, M.B., F.R.C.S.Edin.

Dated March 14, 1916.—John V. Buchanan, M.B.

Dated March 15, 1916.—Edward H. Rainey, F.R.C.S.; John A. D. Radcliffe, M.B. ; Lawrence D. Shaw, M.B. ; Edward C. Williams, M.D., F.R.C.S.Edin.

Dated March 16, 1916.—George R. Lawless, F.R.C.S.I.

Dated March 17, 1916.—William W. Scott, M.B. ; Alfred J. A. Peters; Joseph C. Lorraine, M.B., F.R.C.S.Edin.

Dated March 19, 1916.—Thomas G. Brown, M.D.; Robert Slaney; Charles F. Drew, M.B.

Dated March 20, 1916.—William T. Smith, M.B.; Arthur MacKintosh, M.B.; Thomas Ferguson, M.B. ; Claude J. Scholtz; Bertram W. Gonin.

Dated March 21, 1916.—John Ronald Currie, M.D.; Arthur J. Smith, M.B.

Dated March 22, 1916.—Orme S. Kellett; William E. P. Phillips; Frederick S. Turner; Maxwell J. Fraser, M.D.; Herbert Owen, M.B.; Henry R. Brown, M.D.; William A. Kennedy, M.D.; Courtenay C. Weeks; David L. Tate, M.B.

Dated March 23, 1916.—James R. Mitchell, M.B.; Harold Dyer, F.R.C.S.Edin.; William A. Rees; Edward Rogerson, M.B. ; Reginald B. Lucas, M.B. ; William H. Godby, M.B. ; Norman E. Packer, M.B. ; Charles O. Donovan, M.B.; Robert B. Carter, M.B.; Eric P. Blashki, M.B. ; John L. Digby, M.B. ; Norman McA. Gregg, M.B. ; Norman W. Broughton, M.B. ; Sydney W. G. Ratcliff, M.B.; Clive Farranridge, M.B. ; Arthur W. Raymond, M.B.

Dated March 24, 1916.—William H. Allen, M.D.; Thomas J. J. Curran, M.D.; Francis A. L'Estrange, M.B.

Dated March 25, 1916.—Harry Dudley; John M. McLachlan; Hugh R. Souper, M.B.; Cecil Burnham, M.B.; Herbert, E. Clutterbuck, M.D., F.R.C.S.Edin.; Sydney Williams.

Dated March 26, 1916.—Robert E. F. Pearse; Wilfred N. Soden. M.D.; John W. Robertson, M.D.; Newman Smith; John B. Hunter; Arnold Renshaw, M.B.; Harold J. Penny, M.B.; John J. O'Neill, M.B.; Brian W. Wibberly, M.B.

Dated March 27, 1916.—Thomas P. Noble, M.D.

Dated March 28, 1916.—Gwilym R. Pennant; Thomas W. David; Guy W. Parry.

Dated March 29, 1916.—Andrew R. Gunn, M.B.; Allan R. Finn, M.D., F.R.C.S.; Reginald S. Morshead, M.B.; George M. C. Powell; George W. FitzHenry.

Dated March 30, 1916.—Theodore H. Whittington, M.D.

Dated April 1, 1916.—Joseph H. C. Walker, M.B.; Maurice B. King, M.B.; Roland H. Graham, M.B.

Dated April 4, 1916.—Arthur G. Fisher, M.B.

Dated April 6, 1916.—William Hunt, M.B.; Cecil McL. West, M.B.

Valentine Robert Hirsch, to be temporary Honorary Lieutenant, dated February 25, 1916.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated March 22, 1916.—William Henry Marshall.

Dated March 23, 1916.—Ernest Ivan Davies.

Dated April 8, 1916.—Miles Kenneth Robertson.

Temporary Lieutenant David R. Campbell, M.D., relinquishes his commission on account of ill-health, dated April 14, 1916.

Temporary Lieutenant Clarence Dickinson Hamilton, M.D., is dismissed the Service by sentence of a General Court Martial, dated March 5, 1916.

The undermentioned Officer of the Canadian A.M.C. to be temporary Lieutenant:—

Captain Robert Hay Lismore O'Callaghan, M.D., dated March 13, 1916.

The undermentioned to be Lieutenants:—

Dated March 11, 1916.—Hiram Benson Thomson; Louis Wellington Kergin, M.B.; William Thomson Little; Gordon John Cruikshank Ferrier; Gerald Thomas Griffith; Edward Archibald Morgan; Alexander John Shilstra; Charles William Walker.

Dated March 18, 1916.—Thomas Benjamin Brandon, M.D.

The Christian name of temporary Lieutenant Haydn Peters is as now described, and not as in the *Gazette* of March 3, 1915.

Major (temporary Lieutenant-Colonel) Evelyn J. R. Evatt, M.B., 1st Welsh Field Ambulance, to be A.A.D.M.S., Welsh Division, dated November 24, 1915.

Captain John F. Edmiston, M.B., from Attached to Units other than Medical Units, to be D.A.D.M.S., West Lancashire Division, dated April 22, 1916.

William Wright, M.B., F.R.C.S., to be Lieutenant for service with the Medical Unit of the University of London Contingent, Senior Division, O.T.C., dated March 7, 1916.

Major P. S. Lelean, F.R.C.S., R.A.M.C., was elected to a Fellowship of the Chemical Society (Great Britain), on February 22, 1916.

The undermentioned temporary Lieutenants relinquish their commissions:—

Dated February 8, 1916.—William H. Croly.

Dated February 15, 1916.—Charles S. Palmer.

Dated February 27, 1916.—Lionel R. G. de Glanville.

Dated March 4, 1916.—Harold S. Vivian, M.B.

Dated March 9, 1916.—John W. Farrar, M.B., Donald F. Finlay, M.B., Lionel B. Daly, M.B.

Dated March 10, 1916.—Thomas C. Last, M.D.

Dated March 12, 1916.—Robert N. Thomson, M.B., James R. Wortabet, M.B.

Dated March 15, 1916.—Henry H. R. Bayley, Lionel W. K. Scargill, M.B., Arthur E. Goldie, M.B.

Dated March 16, 1916.—Norman D. Mackay, M.D., Ernest H. Kenny.

Dated March 17, 1916.—Keith G. Colquhoun, M.B., Clive T. Stephen, M.B., Henry C. Colville, M.B., Alan Pryde, M.B.

Dated March 18, 1916.—Francis W. Harrowell, M.B.

Dated March 20, 1916.—Samuel Caplan, Philip A. M. Green, M.D.

Dated March 21, 1916.—James A. Brown, M.D.

Dated March 22, 1916.—Harold J. Moon.
Dated March 23, 1916.—Louis M. Piggott, M.B., John T. Anderson, M.B., Eustace T. Pinhey, M.B.
Dated March 24, 1916.—Evan Greene, M.D., Charles Matthews.
Dated March 25, 1916.—Joseph B. Dawson, M.D., F.R.C.S.
Dated March 26, 1916.—Brian D. Crichton, M.B.
Dated March 27, 1916.—John McG. H. Reid, M.B.
Dated March 29, 1916.—John L. Davies, M.D., Vernon C. Pennell.
Dated March 30, 1916.—Arthur E. Gravelle.
Dated March 31, 1916.—Charles P. M. Joubert, M.B., Ernest H. Drinkwater.
Dated April 15, 1916.—Thomas A. Brandon, M.B., William G. S. Thomson, M.B.

TERRITORIALS.

Royal Army Medical Corps.

1st Highland Field Ambulance.—Captain George Davidson, M.D., to be temporary Major whilst commanding a Field Ambulance, dated October 17, 1915; Captain (temporary Major), George Davidson, M.D., relinquishes his temporary rank on ceasing to command a Field Ambulance, dated November 19, 1915.

Highland Casualty Clearing Station.—Frederick George Stuart, M.B., to be Lieutenant, dated April 5, 1916; William Alexander, M.B., dated April 26, 1916; Arthur Alexander McKenzie, M.B., dated April 26, 1916.

1st Lowland Field Ambulance.—Lieutenant Robert Armstrong, M.B., to be Captain, dated April 11, 1916.

3rd Lowland Field Ambulance.—James Morham (late Captain (temporary Major) 4th Battalion, Royal Scots), to be Captain, dated March 6, 1916.

3rd Northumbrian Field Ambulance.—Vernon Joseph White, to be Lieutenant, dated April 11, 1916.

Welsh Border Mounted Brigade Field Ambulance.—Harold Ainscough Higginson, to be Lieutenant, dated April 5, 1916.

1st Welsh Field Ambulance.—Major (temporary Lieutenant-Colonel) Evelyn J. R. Evatt, M.B., is seconded whilst acting as A.D.M.S., Welsh Division, dated November, 24, 1915.

2nd Welsh Field Ambulance.—John Thomas Samuel, to be Lieutenant, dated April 14, 1916.

South Wales Mounted Brigade Field Ambulance.—John Oswald Cuthbertson, M.B., dated December 20, 1915; Stanley Child, M.B., dated April 26, 1916.

East Lancashire Division Sanitary Section.—Lieutenant Norman S. Golding, from 1st London Sanitary Company, to be Lieutenant, dated April 7, 1916.

1st West Lancashire Field Ambulance.—Captain John E. W. MacFall, M.D., from Territoral Force Reserve, to be Captain, dated November 22, 1915; Captain John E. W. MacFall, M.D., to be temporary Major, dated November 22, 1915. The date of appointment of Quartermaster and Honorary Lieutenant William H. Bell is August 28, 1915, and not as stated in the *London Gazette* of October 29, 1915.

2nd West Lancashire Field Ambulance.—Staff Serjeant Hugh Murdoch Browne, from 1st West Lancashire Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated April 6, 1916.

3rd West Lancashire Field Ambulance.—Captain Frederick W. K. Tough, F.R.C.S., to be temporary Major whilst in command of a Field Ambulance, dated March 17, 1916.

1st North Midland Field Ambulance.—Lieutenant (temporary Captain), Geoffrey Holmes, M.B., to be Captain, dated April 7, 1915.

1st South Midland Mounted Brigade Field Ambulance.—Oswald Cook, M.B., to be Lieutenant, dated April 26, 1916.

South Midland Casualty Clearing Station.—Captain Edmund Whichells, M.B., from 1st South Midland Field Ambulance, to be Captain, dated October 16, 1915.

1st *Wessex Field Ambulance.*—Lieutenant George D. Perry to be Captain, dated April 1, 1215. The following announcement is substituted for that which appeared in the *London Gazette* of September 10, 1915: Captain George D. Perry resigns his commission on account of ill-health, dated September 11, 1915; Serjeant Frederick George Chalmers Dixon to be Quartermaster, with the honorary rank of Lieutenant, dated April 4, 1916.

Wessex Casualty Clearing Station.—Captain Arthur Greene, M.D., F.R.C.S., from 2nd East Anglian Field Ambulance, to be Captain, dated April 22, 1916; Lieutenant James Fenton, M.D., to be Captain, dated March 26, 1916.

1st Southern General Hospital.—Lieutenant William A. Stokes to be Captain, dated November 8, 1915; Lieutenant David R. Dow, M.B., relinquishes his commission on account of ill-health, dated April 20, 1916.

3rd Southern General Hospital.—The undermentioned Majors to be Lieutenant-Colonels, dated January 1, 1916: William Collier, M.D.; Richard H. A. Whitelocke, M.D., F.R.C.S. The undermentioned Captains to be Majors, dated January 1, 1916: Edmund C. Bevers, M.B.; Herbert E. Counsell, F.R.C.S.; John C. R. Freeborn; Alexander G. Gibson, M.D.; Walter J. Turrell, M.D.; Amyas T. Waterhouse, M.B.; Serjeant-Major Thomas Michael Stevens to be Quartermaster, with the honorary rank of Lieutenant, dated April 5, 1916.

Home Counties Casualty Clearing Station.—Temporary Honorary Lieutenant William Burt, from the Red Cross Hospital, Netley, to be Lieutenant, dated April 5, 1916.

1st London Field Ambulance.—Major William G. Macfee, from Attached to Units other than Medical Units, to be Major, dated March 14, 1916.

1st London Sanitary Company.—Captain Vincent P. Norman relinquishes his commission on account of ill-health, dated April 16, 1916; David James Peebles, M.B., to be Lieutenant, dated April 11, 1916; John Griffiths to be Lieutenant, dated April 14, 1916.

2nd London Sanitary Company.—Lieutenant Alexander M. Brown, M.B., to be Captain, dated March 21, 1916; Captain Herbert Beeney relinquishes his commission on account of ill-health, dated April 22, 1916; Acting Serjeant-Major Josiah Alec Andrews to be Lieutenant, dated April 2, 1916.

3rd London Field Ambulance.—Lieutenant (temporary Captain) Robert Carswell, M.B., to be Captain, dated April 1, 1915.

3rd London General Hospital.—Lieutenant Andrew T. Swan, M.B., to be Captain, dated November 17, 1915.

TERRITORIAL FORCE RESERVE.

Captain Robert G. Wills, M.B., from 2nd West Lancashire Field Ambulance, to be Captain, April 15, 1916; Quartermaster and Honorary Captain Sidney Pritchard, from 2nd East Lancashire Field Ambulance to be Quartermaster, with the honorary rank of Captain, dated April 6, 1916.

Transport Officer and Honorary Lieutenant Norman F. Richardson, from South Wales Mounted Brigade Field Ambulance, to be Transport Officer, with the honorary rank of Lieutenant, April 16, 1916.

Captain (temporary Major) Hugh G. Trayer, M.B., relinquishes his temporary rank on ceasing to command a Field Ambulance, dated February 24, 1916.

The undermentioned Cadets, Edinburgh University Contingent, Officers Training Corps, to be Lieutenants (on probation):—

Dated March 23, 1916.—Lance-Corporal William Haig Ferguson, M.B.; Lance-Corporal Hedley Duncan Wright, M.B.; Keith Paterson Brown, M.B.

Dated March 26, 1916.—Cadet Serjeant-Major George Morris, M.B.; Cadet Serjeant John Andrew Crawford, M.B.

Dated April 8, 1916.—George Irving, M.B.

Attached to Units other than Medical Units.

Lieutenant John David Jones to be Captain, dated May 16, 1915

John Muir, M.B., to be Lieutenant, dated October 1, 1915.

Horace Carlos Barr (late temporary Lieutenant, Royal Army Medical Corps) to be Captain, dated December 4, 1915.

Lieutenant Charles W. J. Brasher to be Captain, dated December 31, 1915.

Surgeon-Major Vyner Graham, from 5th Yorks Light Infantry, to be Major, dated January 1, 1916.

Captain Hastings F. Everett to be temporary Major, whilst in command of a Field Ambulance, dated January 25, 1916.

Captain Robert Carswell, M.B., from 3rd London Field Ambulance, to be Captain, dated February 25, 1916.

Lieutenant Donald G. Dingwall to be Captain, dated March 20, 1916.

The date of appointment of Lieutenant Charles Nyhan is March 17, 1915, and not as announced in the *Gazette* of April 6, 1915.

The following announcement is substituted for that which appeared in the *Gazette* of March 10, 1916:—

William Layard Griffiths, M.D., F.R.C.S. (late Captain, Royal Army Medical Corps, Territorial Force), to be Captain, February 12, 1916, with precedence in the Royal Army Medical Corps from October 23, 1915.

Lieutenant Herbert Smith to be Captain, dated March 2, 1916.

Lieutenant Wilfred W. Horton, M.D., to be Captain, dated March 24, 1916.

Lieutenant Douglas L. Wall, M.B., to be Captain, dated April 1, 1915.

George Henry Gill to be Lieutenant, dated April 5, 1916.

Captain Joseph C. Denvir, M.B., from Yorks Mounted Brigade Field Ambulance to be Captain, dated April 7, 1916.

Joseph Stanley Hopwood, M.B., to be Lieutenant, dated April 11, 1916.

Surgeon-Major Edward G. Stocker, from Wessex Divisional Engineers, to be Major, dated April 14, 1916.

Captain William Marley-Cass relinquishes his commission on account of ill-health, dated April 12, 1916.

Major William F. Roe to be temporary Lieutenant-Colonel whilst in command of a Field Ambulance, dated April 23, 1916.

Major John E. B. Wells, from 6th London Field Ambulance, to be Major, dated April 26, 1916.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE IN ROOM 357, ON WEDNESDAY, APRIL 12, AT 3 P.M.

Present.

Surgeon-General M. W. Russell, C.B., in the Chair.
Surgeon-General W. Donovan, C.B.
Lieutenant-Colonel E. M. Wilson, C.B., C.M.G., D.S.O.
Lieutenant-Colonel A. B. Cottell.
Lieutenant-Colonel E. M. Pilcher, D.S.O.

A letter of apology for inability to attend was read from Colonel Lane Notter.

(1) The Minutes of the last meeting were read and confirmed.

(2) The application for grants for the year 1916 were considered, and the Committee recommended the following grants for the approval of the Annual General Meeting:—

Three orphans of the late Staff-Surgeon D. O. D.	£30
Orphan of Surgeon-Major C. Q.	30
Orphan of Inspector-General D. A.	35
Orphan of Surgeon-General A. S.	20
Orphan of Lieutenant-Colonel H. C., subject to a medical certificate of ill-health	25
Orphan of Surgeon-General J. O.	40
Orphan of Surgeon-General W. F. I.	40
Orphan of Surgeon-General T. B.	40
Orphan of Surgeon-Major B. C. S...	35
Orphan of Major P. G. I.	30
and Mrs. Grigor's Pension	10
Three orphans of Captain G. C.	40
Orphan of Surgeon-General R. O.	30
Orphan of Surgeon-General J. W. M.	20
Orphan of Staff-Surgeon J. W. C.	25
Orphan of Surgeon-General J. F.	30
Orphan of Surgeon-General W. T. H.	25
Orphan of Lieutenant-Colonel H. J. P.	10
Orphan of Captain T. S.	20
Two orphans of Captain R. D. O'C.	20
Orphan of Lieutenant-Colonel R. J. H.	20
Three orphans of Lieutenant-Colonel T. McC.	40
Thirty-eight orphans recommended to receive	665

(3) The Committee having considered the following cases were unable to recommend any grant :—

Orphan of Major W. P. F., for being over twenty-one years of age; orphan of Captain H. H. S., for not being educated or maintained by the applicant.

(4) It was resolved to invest £200 in 5 per cent. Exchequer Bonds. The Secretary was directed to request the Bankers to have this done in the names of the Trustees.

(5) It was noted that the Annual General Meeting will be held in the Royal Army Medical College Library, at 3 p.m., on June 12.

F. W. H. Davie Harris, *Lieutenant-Colonel,*
Secretary.

Notice of the Annual General Meeting.

The Annual General Meeting of subscribers to this Society will be held in the Library of the Royal Army Medical College, Grosvenor Road, S.W., at 3 p.m., on Monday, June 12, 1916.

The Director-General will preside.

It is hoped that all officers will freely express their views on any point connected with the Society. Those officers who may wish for information on any special point are requested to communicate with the Secretary, so that the necessary information may be furnished in response to any question asked.

F. W. H. Davie Harris,
Lieutenant-Colonel
Secretary.

124, *Victoria Street, S.W.*

ROYAL ARMY MEDICAL CORPS FUND.

Proceedings of a Committee Meeting held at the War Office on Wednesday, April 12, 1916, in Room 357.

Present.

Surgeon-General Sir Alfred Keogh, K.C.B., F.R.C.S., D.G., A.M.S., in the Chair.
Surgeon-General M. W. Russell, C.B.
Surgeon-General W. Donovan, C.B.
Lieutenant-Colonel E. M. Wilson, C.B., C.M.G., D.S.O.
Lieutenant-Colonel W. Pope.
Lieutenant-Colonel E. M. Pilcher, D.S.O.
Lieutenant-Colonel G. St. C. Thom.
Major W. Ward.

A letter of apology for absence was read from Captain F. Crookes. Lieutenant-Colonel Thom took his seat on the Committee, *vice* Lieutenant-Colonel W. Blackwell, and Lieutenant-Colonel Wilson, *vice* Lieutenant-Colonel E. O. Wight, deceased, as a representative of retired officers.

(1) The Minutes of the last Meeting were read and confirmed.

(2) The grants received for the General Relief Fund, from the past quarter from Companies and Units of the Corps, in response to the circular letter sent out under Minute 4 of the last Meeting, aggregating £1,157 9s., were noted, and a list is appended to these Proceedings.

(3) A grant of £4 from the General Relief Fund to Mrs. E. D., of Aldershot, was sanctioned.

(4) The Band Accounts for the last two quarters were considered and passed. The Band President was requested to, in future, show all receipts from every source in his statement of accounts.

(5) A letter was read from Surgeon-General Jencken, one of the Auditors, saying that he had inspected all the shares certificates of the investments of the Fund.

(6) It was noted that the Annual General Meeting will be held in the Library of the Royal Army Medical College, at 2.30 p.m., on Monday, June 12. The Director-General has kindly consented to preside.

(7) It was resolved that £1,800 from the General Relief Fund, and £600 from the Corps Fund, be invested in 5 per cent. Exchequer Bonds. The Secretary was directed to request the Bankers to have these investments carried out as soon as possible, the

ROYAL ARMY MEDICAL CORPS.

BAND FUND.

Quarter ending December 31, 1915.

RECEIPTS.

1915.		£	s.	d.
December 8.	Subscription as per Pass Book	0	5	0
October 22.	Cheque, R.A.M.C. Fund	60	0	0
December 8.	,, ,, ,, ...	38	0	0
	Balance brought forward	4	11	8
		£102	16	8

EXPENDITURE.

1915.		£	s.	d.	£	s.	d
October 4.	Overdraft at Bank at September 30, 1915				15	0	4
November 2.	Bandmaster's Salary for Quarter ending December 31, 1915	30	0	0			
December 7.	Bugler Serjeant Smith for Quarter ending December 31, 1915	4	11	0			
					34	11	0
,,	Petty Cash Payments (Storeman)				1	0	0
October 2.	As per Pass Book, insufficently stamped letter	0	0	2			
	Cheque Book	0	4	2			
					0	4	4
	Petty Cash Balance in hand				3	11	8
	Balance in hand, December 31, 1915				48	9	4
					£102	16	8

Examined and found correct,

J. P. LYNCH, *Major R.A.M.C.*, *President.*
J. W. LAING, *Captain*, } *Members.*
H. BEDINGFIELD, *Captain*, }

THE ROYAL ARMY MEDICAL CORPS.

Band Fund.

***Quarter ending March* 31, 1916.**

Receipts.

1916.	£	s.	d.
By Balance at this date as per Pass Book	48	9	4
,, ,, ,, ,, Petty Cash	3	11	8
,, Subscriptions as per Pass Book	0	10	0
,, Cheque, R.A.M.C. Fund	50	0	0
	£102	11	0

Expenditure.

1916.	£	s.	d.
Bandmaster's Salary, quarter ending March 31, 1916	30	0	0
Bugler Serjeant Smith's Salary, quarter ending March 31, 1916	4	11	0
Messrs. Hawkers and Co.	24	4	0
,, Boosey	6	12	8
,, Elkin and Co.	0	15	6
,, Gale and Polder	0	12	0
,, Boosey and Co.	1	13	4
,, Hawkers and Sons	4	3	4
Petty Cash Payments:—			
Storeman for quarter ending March 31, 1916 ..	0	15	0
Messrs. Rudall, Carte and Co.	0	3	6
Mr. Bradley, Expenses to London	0	8	0
Bugler Serjeant Smith (Repairs)	0	2	7
Sundry Postages for Quarter	0	1	11½
Balance in hand, per Pass Book	26	7	6
,, ,, ,, Petty Cash	2	0	7½
	£102	11	0

Audited and found correct,

T. W. LEESON, *President.*
J. R. LAING } *Members.*
A. T. STRINGER }

former amount under the General Relief Trust Fund, and the latter in the names of the Royal Army Medical Corps Fund Trustees.

(8) It was resolved that a bill of £5 for printing 200 Easter cards, which were sent to the Medical Officers of the Russian Army by the Director-General and officers of the Medical Services of the British Army, should be defrayed from the Royal Army Medical Corps Fund.

A description of the card, and a copy of a letter from Sir Alfred Keogh to the Director-General of the Russian Army, appeared in the April issue of the CORPS NEWS.

(9) The question was raised as to the future of the Compassionate School Fund, as its finances are now drawing to a close. The Chairman considered, and the Committee agreed, that it is a question for the Annual General Meeting to decide as to whether the General Relief Fund should be burdened by carrying on the work that has been previously done by the School Fund. The Compassionate School was started after the South African War, by a sum of money of about £1,300, which was earmarked at the request of Colonel Somerville Large for the purpose of maintaining and educating orphans of N.C.O's. and men of the Corps who were in the South African War. It was resolved that the question should be brought before the next Annual Meeting for consideration. Should it be decided that the General Relief Fund shall continue the work now done by the School Fund, the further point will arise as to whether the latter fund shall be closed at the end of this year, and any balance then transferred to the General Relief Fund.

F. W. H. DAVIE HARRIS, *Lieutenant-Colonel*,
124, *Victoria Street, S.W.* *Secretary.*

NOTICE OF THE ANNUAL GENERAL MEETING.

THE Annual General Meeting of subscribers to this Fund will be held in the Library of the Royal Army Medical College, Grosvenor Road, S.W., at 2.30 p.m., on Monday, June 12, 1916.

The Director-General will preside. It is hoped that all officers will freely express their views on any point connected with the Fund. Those officers who may wish for information on any special points are requested to communicate with the Secretary, so that the necessary information may be furnished in response to any question asked.

F. W. H. DAVIE HARRIS,
Lieutenant-Colonel,
124, *Victoria Street, S.W.* *Secretary.*

GENERAL RELIEF FUND.

Contributions received during the Quarter ending March 31, 1916.

COMPANIES.

No. 2	Aldershot	£5	0	0
—	Aldershot	500	0	0
—	Netley	5	0	0
,, 6	Cosham	20	0	0
,, 7	Devonport	30	0	0
,, 9	Colchester	5	0	0
,, 10	Chatham	5	0	0
,, 12	Woolwich	5	0	0
,, 13	Edinburgh	2	2	0
,, 15	Belfast	10	0	0
,, 16	Cork	4	11	0
,, 17	Curragh	5	0	0
,, 18	Rochester Row	3	0	6
,, 22 & 23	South Africa	27	10	0
,, 28	Gibraltar	7	7	0
,, 29	Egypt	50	0	0
,, 30	Malta	3	0	0
,, 31	Mauritius	18	16	8

FIELD AND OTHER UNITS.

R.A.M.C.	Whalley	£25	0	0
,,	Lichfield	60	0	0
Training Centre	Sling	100	0	0
,, ,,	Farnham	25	0	0
,, ,,	Limerick	10	0	0
R.A.M.C.	Exeter	2	9	0
,,	St. David's Hospital, Malta	10	0	0
,,	No. 1 Malta Company	5	0	0
,,	Forrest, Malta	1	0	0
,,	Spinola, Malta	5	0	0
,,	Valetta, Malta	5	0	0
,,	Tigue, Malta	3	15	0
,,	Gharri Tuffiela	5	0	0
,,	St. George's Hospital	20	0	0
,,	St. John Hospital	5	0	0
No. 2	General Hospital	10	0	0
,, 5	,, ,,	10	0	0
,, 66	,, ,,	8	10	0
,, 17	,, ,,	10	10	0
,, 30	,, ,,	6	0	0
,, 1	Cavalry Field Ambulance	1	10	0
,, 4	,, ,, ,,	2	10	0
,, 5	,, ,, ,,	2	3	0
,, 6	Field Ambulance	3	11	6
,, 11	,, ,,	8	6	0
,, 16	,, ,,	7	3	4
,, 33	,, ,,	16	10	0
,, 36	,, ,,	7	0	0
,, 48	,, ,,	3	3	0
,, 50	,, ,,	7	3	0
,, 55	,, ,,	15	0	0
,, 74	,, ,,	3	3	0
,, 77	,, ,,	10	0	0
,, 1	Casualty Clearing Station	5	0	0
,, 4	,, ,, ,,	3	0	0
,, 14	,, ,, ,,	3	15	0
,, 18	,, ,, ,,	5	0	0
,, 19	,, ,, ,,	10	0	0
,, 10	Stationary Hospital	10	0	0
—	Lady Saunders and Miss Eastwood	20	0	0
		£1,177	9	0

NOTICE.

THE Thirty-sixth Annual General Meeting of the British Dental Association will be held in the Hall of the Royal Society of Medicine, 1, Wimpole Street, W., on Thursday, Friday, and Saturday, June 15, 16, and 17, 1916.

PROVISIONAL PROGRAMME.

Thursday, June 15.

9.30 a.m. Representative Board Meeting.
11.30 a.m. Annual Meeting of Members.
2.30 p.m. General Meeting. Papers and Discussion on War Injuries of the Jaws.
First Subject.—Early Treatment of Jaw Injuries.

Friday, June 16.

10.30 a.m. *Second Subject.*—Appliances and Splints.
(*a*) Reduction of Displaced Portions of Bone by Immediate and Gradual Methods, and Retention of Parts in Normal Position during Period of Union.
(*b*) Restoration of Lost Parts by Prosthetic Apparatus.

2.30 p.m. *Third Subject.*—Restoration of Lost Portions of the Jaw by Surgical Means—*e.g.*, Bone-grafting, Bone-plating and Wiring, Splints embedded in the Soft Tissues.

4.30 p.m. Demonstrations.

Saturday, June 17.

10.30 a.m. *Fourth Subject.*—Treatment of Ununited Fracture and Malunion.
Fifth Subject.—Diet, Massage, and Dynamic Exercises.

A Museum Sub-committee has been appointed to arrange for Exhibits of appliances, models, photographs, &c., relating to War Injuries of the Jaws.

(*By Order*) FRANK J. PEARCE,
Hon. Secretary.

BIRTH.

SKRIMSHIRE.—At St. Thomas's Mount, Madras, on March 18, 1916, wife of Captain F. Skrimshire, R.A.M.C., of a daughter.

DEATHS.

LAMBERT.—Major Francis Courtenay Lambert, R.A.M.C., died on active service on March 29, 1916.

BEVERIDGE. — Surgeon-Major Alexander Watt Beveridge, M.D., A.M.S., retired pay, died at 26, Buckingham Terrace, Edinburgh, on April 9, 1916.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of EXCERPTS *	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2	4 3	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 1s. 8d. net; binding, 1s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," War Office, Whitehall, London, S.W.

Communications have been received from Colonel W. P. Herringham, Lieutenant-Colonel R. H. Cordner, Major A. C. H. Gray, Serjeant-Major E. B. Dewbery, Captain C. T. W. Hirsch, Captain W. Anderson, Captain J. W. McNee, Captain H. R. Brown, Captain A. Renshaw, Captain J. McDonnell, Captain F. C. Davidson, Major C. W. Duggan, Alan H. Todd, Esq., Major V. Nesfield, Captain J. B. Fisher.

The following publications have been received:—

British: The Lancet, Transactions of the Society of Tropical Medicine and Hygiene, St. Bartholomew's Hospital Journal, Public Health, The Journal of Tropical Medicine and Hygiene, Medical Press and Circular, The Hospital, The Medical Review, The British Journal of Tuberculosis, The Practitioner, Guy's Hospital Gazette, Red Cross and Ambulance News, The South African Institute for Medical Research, The St. Thomas's Hospital Gazette, The Journal of State Medicine, The Medical Journal of Australia, Journal of the Royal Naval Medical Service, Tropical Diseases Bulletin.

Foreign: Bulletin de l'Institut Pasteur, Russian Naval Medical Journal, Revista de Sanidád Militar, United States Naval Medical Bulletin, Bulletin of the Johns Hopkins Hospital, United States Public Health Service, Le Caducée, Tidskrift i Militär Hälsovard, The Journal of Infectious Diseases, Archives de Médecine et de Pharmacie Militaires, Office International d'Hygiène Publique.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

JUNE, 1916.

EXTRACT FROM THE "LONDON GAZETTE," MAY 2, 1916.

CENTRAL CHANCERY OF THE ORDERS OF KNIGHTHOOD.

Lord Chamberlain's Office,
St. James's Palace, S.W.
May 2, 1916.

The King has been graciously pleased to give orders for the following appointments to the Most Honourable Order of the Bath, for distinguished service in the Field. The appointments to date from January 1, 1916:—

To be Additional Members of the Military Division of the Third Class, or Companions, of the said Most Honourable Order:—

Temporary Colonel William Hunter, M.D., F.R.C.P., Army Medical Service.

Temporary Colonel Charles Alfred Ballance, M.V.O., M.B., F.R.C.S., Army Medical Service.

Temporary Colonel Arthur William Mayo Robson, C.V.O., F.R.C.S., D.Sc., Army Medical Service.

Temporary Colonel Vincent Warren Low, M.D., F.R.C.S., Army Medical Service.

Temporary Colonel James Purves Stewart, M.D., F.R.C.P., Army Medical Service.

Temporary Colonel Charters James Symonds, M.D., F.R.C.P., Army Medical Service.

Temporary Colonel William Thorburn, M.D., F.R.C.S., Army Medical Service.

Temporary Colonel Charles Snodgrass Ryan, M.B., Army Medical Service (Colonel, Australian Army Medical Corps).

Temporary Colonel Frederic Dougan Bird, M.B., F.R.C.S., Army Medical Service.

Temporary Colonel Sir Victor Alexander Hadon Horsley, F.R.S., M.B., F.R.C.S., Army Medical Service.

CHANCERY OF THE ORDER OF SAINT MICHAEL AND SAINT GEORGE.

Downing Street,
May 2, 1916.

The King has been graciously pleased to give directions for the following promotion in and appointments to the Most Distinguished Order of Saint Michael and Saint George, for distinguished service in the Field. To be dated January 1, 1916:—

To be an Additional Member of the Second Class, or Knights Commanders, of the said Most Distinguished Order:—

Surgeon-General William Babtie, V.C., C.B., C.M.G., M.B., K.H.S.

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order:—

Temporary Colonel Alfred Herbert Tubby, M.B., F.R.C.S., Army Medical Service.

Temporary Colonel Archibald Edward Garrod, M.D., F.R.S, Army Medical Service.

Temporary Colonel Fleming Mant Sandwith, M.D., F.R.C.P., Army Medical Service.

Temporary Colonel William Henry Willcox, M.D., F.R.C.P., Army Medical Service.

Major (temporary Lieutenant-Colonel) Creighton Hutchinson Lindsay, M.D., R.A.M.C., (T.F.).

CANADIAN ARMY MEDICAL CORPS.

Lieutenant-Colonel Frederick Etherington.
Lieutenant-Colonel Samuel Hansford McKee.
Major Evans Greenwood Davis.

War Office,
May 2, 1916.

His Majesty the King has been graciously pleased to approved of the undermentioned rewards for Distinguished Service in the Field, with effect from January 1, 1916:—

To be Companions of the Distinguished Service Order:—
Lieutenant-Colonel Ernest Victor Gostling, R.A.M.C. (T.F.)
Major John Grenvill Bell, M.B., R.A.M.C.

AWARDED THE MILITARY CROSS.

Temporary Captain Walter Netherwood Rishworth, M.B., R.A.M.C.

The undermentioned ladies are awarded the Royal Red Cross Decoration:—

QUEEN ALEXANDRA'S IMPERIAL MILITARY NURSING SERVICE.

1st Class.

Miss E. R. Collins, Sister.
Miss K. F. Fawcett, Sister, Acting Matron.
Miss M. German, Sister, Acting Matron.
Miss C. C. M. Gibb, Sister, Acting Matron.
Miss M. H. Graham, Staff Nurse, Acting Sister.
Miss S. W. Wooler, Sister, Acting Matron.

TERRITORIAL FORCE NURSING SERVICE.

1st Class.

Miss M. Acton, Matron.
Miss M. A. Harvey, Matron.
Miss W. M. B. Friend, Sister, Acting Matron.
Miss K. Mann, Sister, Acting Matron.

2nd Class.

Miss M. C. Coxeter, Sister.
Miss A. Hills, Sister.
Miss K. C. Jones, Sister.
Miss M. Newbould, Sister.

QUEEN ALEXANDRA'S IMPERIAL MILITARY NURSING SERVICE (RESERVE).

1st Class.

Miss A. E. Holmes, Acting Matron.

2nd Class.

Miss A. G. Boyd, Sister.
Miss J. Frewin, Staff Nurse.
Miss M. M. McNab, Staff Nurse.
Miss E. Moore, Sister.
Miss H. E. Prefrement, Staff Nurse.
Miss A. H. Wormald, Sister.

AUSTRALIAN NURSING SERVICE.

1st Class.

Miss G. Wilson, Matron.

2nd Class.

Miss B. Pocock, Sister.
Miss E. Peters, Sister.
Miss D. D. Richmond, Sister.
Miss F. E. Spalding, Sister.

A further list of rewards, including Distinguished Conduct Medals, and Military Medals, will be announced next month.

EXTRACT FROM THE "LONDON GAZETTE," MAY 5, 1916.

War Office,
May 5, 1916.

The following names, which through various causes could not be included at the time, are now added to the list of officers and men mentioned in General Sir Ian Hamilton's despatch of December 11, 1915 (published in a supplement to the *London Gazette*, dated January 28, 1916) :—

Army Medical Service and Royal Army Medical Corps.

Surgeon-General W. Babtie, V.C., C.B., C.M.G., M.B., K.H.S.
Temporary Colonel C. A. Ballance, M.V.O., M.B., F.R.C.S.
Temporary Colonel F. D. Bird, M.B., F.R.C.S.
Temporary Colonel A. E. Garrod, M.D., F.R.S.
Temporary Colonel Sir V. A. H. Horsley, F.R.S., M.B., F.R.C.S.
Temporary Colonel W. Hunter, M.D., F.R.C.P.
Temporary Colonel V. W. Low, M.D., F.R.C.S.
Temporary Colonel A. W. M. Robson, C.V.O., F.R.C.S., D.Sc.
Temporary Colonel C. S. Ryan, M.B. (Colonel Australian Army Medical Corps).
Temporary Colonel J. P. Stewart, M.D., F.R.C.P.
Temporary Colonel C. J. Symonds, M.D., F.R.C.S.
Temporary Colonel F. M. Sandwith, M.D., F.R.C.P.
Temporary Colonel W. Thorburn, M.D., F.R.C.S.
Temporary Colonel A. H. Tubby, M.B., F.R.C.S.
Temporary Colonel W. H. Willcox, M.D., F.R.C.P.
Major J. G. Bell, R.A.M.C.
Temporary Lieutenant W. N. Rishworth, R.A.M.C.

Royal Army Medical Corps, Territorial Force.

Lieutenant-Colonel E. V. Gostling.
Major (temporary Lieutenant-Colonel) C. H. Lindsay, M.D.
No. 1554 Private W. E. Lloyd, 88th Field Ambulance.

Queen Alexandra's Imperial Military Nursing Service.

Sister (Acting Matron) Miss K. F. Fawcett.
Sister (Acting Matron) Miss M. German.
Sister (Acting Matron) Miss C. C. M. Gibb.
Sister (Acting Matron) Miss S. W. Wooler.
Sister Miss E. R. Collins.
Staff Nurse (Acting Sister) Miss M. H. Graham.

Queen Alexandra's Imperial Military Nursing Service (Reserve).

Acting Matron Miss A. E. Holmes.
Sister Miss A. G. Boyd.
Sister Miss E. Moore.
Sister Miss A. H. Wormald.
Staff Nurse Miss J. Frewin.
Staff Nurse Miss M. M. McNab.
Staff Nurse Miss H. F. Prefrement.

Territorial Force Nursing Service.

Matron Miss M. Acton.
Matron Miss M. A. Harvey.
Sister (Acting Matron) Miss W. M. B. Friend.
Sister (Acting Matron) Miss K. Mann.
Sister Miss M. C. Coxeter.
Sister Miss A. Hills.
Sister Miss K. C. Jones.
Sister Miss M. Newbould.

Australian Nursing Service.

Matron Miss G. Wilson.
Sister Miss E. Peters.
Sister Miss B. Pocock.
Sister Miss D. D. Richmond.
Sister Miss F. F. Spalding.

CANADIAN ARMY MEDICAL CORPS.

Lieutenant-Colonel F. Etherington.
Lieutenant-Colonel S. H. McKee.
Major E. G. Davis.

EXTRACT FROM THE "LONDON GAZETTE" OF TUESDAY, MAY 16, 1916.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned officer to be Companion of the Distinguished Service Order, in recognition of his gallantry and devotion to duty in the field :—

Temporary Captain Robert McCowan Hill, M.B., R.A.M.C. (attached 2nd Battalion A. and S.H.

For conspicuous gallantry and devotion to duty. He went to an area which was under intense bombardment, amputated the leg of a wounded officer, and attended to other wounded, under most dangerous and difficult circumstances. Finally, he accompanied two stretcher cases back under shell fire.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned officer, in recognition of his gallantry and devotion to duty in the field :—

Temporary Captain James Lennox Stewart, M.B., R.A.M.C., attached 1st Battalion Gordon Highlanders.

For conspicuous gallantry and devotion to duty on several occasions when tending the wounded under heavy fire. On one occasion he rallied men and set a splendid example of coolness and bravery.

EXTRACT FROM THE "LONDON GAZETTE" OF MAY 18, 1916.

War Office,
May 18, 1916.

His Majesty the King has been graciously pleased to grant unrestricted permission for the wearing of the Decorations specified against the undermentioned Officers' names, in recognition of their distinguished services during the Campaign :—

Decorations conferred by His Majesty the King of Serbia on members of the Royal Army Medical Corps Mission to Serbia, March to June, 1916 :—

Captain Norman Cameron, M.B., Order of St. Sava, 5th Class.
Temporary Captain John Matthewson Clements, M.D., Order of St. Sava, 5th Class.
Temporary Captain Bernard Creasy Ewens, Order of St. Sava, 5th Class.
Temporary Captain Alexander Keith Forbes, M.B., Order ot St. Sava, 5th Class.
Temporary Captain Charles Michael Forster, Order of St. Sava, 5th Class.
Temporary Captain John McAdam Hill, M.B., Order of St. Sava, 5th Class.
Temporary Colonel William Hunter, C.B., M.D., F.R.C.P., Order of St. Sava, 2nd Class.
Captain Sydney Walker Lund, M.B., Order of St. Sava, 4th Class.
Temporary Captain Samuel Edward McClatchey, M.B., Order of St. Sava, 5th Class.
Temporary Captain Charles Rowley Nicholson, Order of St. Sava, 5th Class.
Temporary Captain Thomas Holmes Ravenhill, M.B., Order of St. Sava, 5th Class.
Temporary Captain Hugh Young Riddell, M.B., Order of St. Sava, 5th Class.
Temporary Captain John Henry Victor Scott, M.B., Order of St. Sava, 5th Class.
Temporary Captain Philip John Ambrose Seccombe, M.B., Order of St. Sava, 5th Class.
Temporary Captain Bryce McCall Smith, M.B., Order of St. Sava, 5th Class.
Temporary Captain Charles Edgar Holton Smith, Order of St. Sava, 5th Class.
Temporary Captain Robert Haig Spittal, M.B., Order of St. Sava, 5th Class.
Lieutenant-Colonel George Elliott Frank Stammers, Order of St. Sava, 3rd Class.
Temporary Captain Lewis Augustus Walker, M.D., Order of St. Sava, 5th Class.
Captain Edward Sancton Walls, Order of St. Sava, 5th Class.
Temporary Captain Gerald Whittington, M.B., Order of St. Sava, 5th Class.
Temporary Captain John Samuel Williamson, Order of St. Sava, 5th Class.
Temporary Captain William Miller Will, M.B., Order of St. Sava, 5th Class.
Francis Frederick Brown, Esq. (late Lieutenant, Royal Army Medical Corps), Order of St. Sava, 5th Class.
William Whiteman Carlton Topley, Esq. (late Captain, Royal Army Medical Corps), Order of St. Sava, 4th Class.

ARMY MEDICAL SERVICE.

Surgeon-General Thomas M. Corker, C.B., K.H.P., is retained on the Active List, under the provisions of Articles 120 and 522, Royal Warrant for Pay and Promotion, 1914, and to be supernumerary, dated May 2, 1916.

Colonel James M. Irwin, M.B., to be temporary Surgeon-General, whilst a Director of Medical Services, dated April 1, 1916.

Colonel James Maher, C.B., to be temporary Surgeon-General whilst a Director of Medical Services, dated April 10, 1916.

The undermentioned Lieutenant-Colonels to be temporary Colonels whilst Assistant Directors of Medical Services:—

Dated March 23, 1916.—James D. Alexander, M.B.

Dated March 24, 1916.—Arthur W. Hooper, C.M.G., D.S.O.

Lieutenant-Colonel Ernest V. Gostling, from 1st East Anglian Field Ambulance, to be Assistant Director of Medical Services, East Anglian Division, with the temporary rank of Colonel, dated April 17, 1916.

Lieutenant-Colonel Thomas F. Dewar, M.D., from Deputy Assistant Director of Medical Services, to be Assistant-Director of Medical Services, 1st Army Central Force, with the temporary rank of Colonel, dated March 7, 1916.

ROYAL ARMY MEDICAL CORPS.

Major J. Galloway, M.D., F.R.C.P., F.R.C.S., Royal Army Medical Corps, Territorial Force, to be temporary Colonel, dated April 18, 1916.

The undermentioned are granted temporary rank whilst Commanding Field Ambulances:—

Majors to be Lieutenant-Colonels: Thomas E. Fielding, D.S.O., M.B., from November 26, 1914, to August 26, 1915; Herbert St. M. Carter, D.S.O., M.D., from July 1, 1915, to January 2, 1916; Charles H. Turner, D.S.O., dated August 24, 1915; George E. Ferguson, dated October 15, 1915; Frederick E. Roberts, D.S.O., from October 15, to December 21, 1915.

Captains to be Majors: Herbert St. M. Carter, D.S.O., M.D., from January 10 to June 30, 1915; Frederick E. Roberts, D.S.O., from August 26 to October 14, 1915; George E. Ferguson, from September 26 to October 14, 1915; Andrew R. Wright, dated December 3, 1915; Ernest C. Phelan, M.B., dated December 5, 1915; Thomas D. H. Robinson, M.B., dated February 3, 1916; Archibald S. Littlejohns, dated March 3, 1916; Augustus S. Williams, dated March 5, 1916; Victor C. Honeybourne, dated March 6, 1916.

Cecil Charles Coghlan, M.B., is granted the temporary honorary rank of Lieutenant whilst serving with the Australian Voluntary Hospital, dated April 19, 1916.

Lieutenant Alexander Barnett Brook, M.B., from Seaforth Highlanders, Territorial Force, to be temporary Lieutenant, dated May 17, 1915. (Substituted for the notification in the *Gazette* of June 15, 1915.)

The undermentioned Officers of the Canadian Army Medical Corps, to be temporary Lieutenants:—

Dated March 28, 1916.—Captain Herbert Bowen Maxwell.

Lieutenants: Dated April 1, 1916.—Charles Edward Allan Trow, M.B.; George Stewart, M.B.; Laurence Bernard Wilfred Braine, M.D.; Thomas William Fingland MacKnight, M.D.; Ellis Carleton Arthur Reynolds, M.D.; Robert Alexander McKay, M.B.; John Ernest O'Donnell, M.D.; David Lockhart MacKenna, M.B.; Harry Gordon Joyce; George Franklin Nelson, M.D.

The undermentioned Majors to be temporary Lieutenant-Colonels:—

Hugh H. J. Fawcett, whilst commanding a Field Ambulance, from June 7, 1915, to January 3, 1916, and from February 8, 1916.

Richard B. Hole, M.B., whilst commanding a Casualty Clearing Station, March 30, 1916.

The following is substituted for the notifications in the *Gazettes* of April 5 and 11, 1916, respectively:—

To be temporary Lieutenant-Colonels whilst commanding Casualty Clearing Stations:—

Dated January 22, 1915.—Major Daniel L. Harding, D.S.O., F.R.C.S.I.

Dated September 14, 1915.—Major Richard F. Ellery.

The name of Captain (temporary Major) Thomas T. H. Robinson, M.B., is as now described, and not as in the *Gazette* of April 18, 1916.

Major Henry Hewetson, to be temporary Lieutenant-Colonel whilst in command of a Stationary Hospital, from August 27, 1914, to February 28, 1915.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst in command of Field Ambulances:—

Dated September 27, 1915.—Walter F. H. Vaughan.

Arthur E. S. Irvine, D.S.O., vice Major (temporary Lieutenant-Colonel) Edward M. Pennefather, who relinquishes the rank of temporary Lieutenant-Colonel on reposting. dated March 25, 1916.

The undermentioned Captains to be temporary Majors whilst in command of Field Ambulances:—

Frank A. McCammon, from February 3 to March 4, 1916.

Clarence H. Denyer, dated February 5, 1916.

Vincent T. Carruthers, dated March 5, 1916.

Gilbert H. Dive, vice Major (temporary Lieutenant-Colonel) Henry E. J. A. Howley, who relinquishes the rank of temporary Lieutenant-Colonel on reposting, dated March 13, 1916.

Christopher Thackray Parsons, M.D., to be temporary Major whilst serving with the Fulham War Hospital, dated April 1, 1915. (Substitued for the notifications which appeared in the *Gazettes* of May 15 and July 10, 1915.)

Harold Dearden to be temporary Honorary Captain whilst employed with No. 3 British Red Cross Hospital, dated May 4, 1916.

The undermentioned Majors to be temporary Lieutenant-Colonels whilst commanding Royal Army Medical Corps Training Centres. Dated April 21, 1916. Arthur H. Safford, Barry A. Craig, Charles R. Sylvester-Bradley, Thomas H. Gibbon, M.D.

The undermentioned are granted temporary and honorary rank whilst serving with the British Red Cross Hospital, Netley. Dated May 13, 1916. As Major: Temporary Honorary Captain Henry L. Tidy, M.D. As Lieutenants: Harold Joseph Wallace, Richard Stanley Topham, M.B., Leonard Whittaker Sharp.

The undermentioned temporary Lieutenants to be temporary Captains:—

Dated March 3, 1916.—Royden McI. Muir, M.B.

Dated March 8, 1916.—Ray H. Rollinson-Whitaker, F.R.C.S.

Dated March 20, 1916.—Joseph Dunbar, M.B.

Dated March 25, 1916.—James H. Johnston.

Dated March 28, 1916.—Anthony H. Corley.

Dated March 29, 1916.—Ernest Weatherhead, M.B.; Meilor Bridgman, M.D.

Dated April 1, 1916.—Benjamin T. Saunders, M.B.; Reginald Williams; Charles J. Gibson, M.D.

Dated April 3, 1916.—William B. Lawrence.

Dated April 1, 1916.—Ian M. Grant, M.D.: Guy B. Nicholson; Arthur R. Rendle, M.D.; George D. Fairley, M.B.; Thomas B. Carlyon; William H. Sheffield, M.B.; Duncan Wood, F.R.C.S.; John Keag; Kenneth H. A. Kellie, M.B.; William Gilbertson, M.D.; Ernest G. Bourdas, M.D., F.R.C.S.Edin.; Ernest P. Satchell, M.B.; Howell W. Barnes, M.B.; John H. J. Davys; Karl F. Sonntag, M.D.; Hans A. C. Swertz, M.B.; John B. Walker; Harold J. de Brent; Arthur D. Howard, M.D.; Percy Kitchin; Philip H. Hadfield; John C. Glen; David Gillies; Arthur Emery, M.B.; James B. Alexander, M.B.; Charles A. Robinson, M.B.; John P. Howe; Herbert H. Folker; Leslie H. Walsh, M.D.: Frank Bryan, M.B.: Charles C. de B. Daly, M.B.; Benjamin H. Leigh: Sidney C. Dyke; William N. Parker, M.D.; Thomas W. Kelly, M.D.; William B. Heywood, M.D.; Robert A. Flynn; William Beck; Edward F. Greene; Sidney H. Hall, M.B.; Frederick G. Bullmore: Hubert R. Sedgwick, M.B.; Ernest Allan, M.B.: John D. Gunn, M.D., F.R.C.S.Edin; David C. Graham, M.B.; Robert L. Ritchie, M.B.; Emanuel M. J. O'Farrell, F.R.C.S.I.; William C. W. Glenny; James A. Gentle, M.B.; John C. Rix; William Hutchison, M.B.; John Wylie, M.B.; Bernard H. S. Aylward, M.B.; Ernest A. Aylward, M.B.; Archibald G. H. Smart, M.B.

Dated April 2, 1916.—Robert McC. Paterson; Walter Haward, M.B.; Bernard S. Browne, M.B., Charles Butler, M.D.; Robert Denman; John D Gimlette; Ernest R. Stone; William D. Wilkins, M.B.; William Harvey, M.B.

Dated April 3, 1916.—Harold B. Taylor; Henry B. Shepherd: James Craig, M.D.; Philip A. McCarthy, M.D.; William A. Slater; Harry Grey, M.D.

Dated April 4, 1916.—Bruce M. Carruthers, M.B.; Charles H. Armitage, M.B.; Francis J. Fahy, M.B.; Gordon A. Renwick, M.D.; John R. MacCulloch, M.B.; Charles G. Adams, M.B.; Charles R. R. Huxtable, M.B.

Dated April 5, 1916.—Edwin W. S. Martin, M.B.

Dated April 6, 1916.—William J. F. Symons, M.B.; Richard A. Banbury; Thomas Johnston; Arthur G. Southcombe, M.D.; Wilfred V. Robinson; Basil W. Cohen, M.B; Norman C. Talbot, M.B.; Frederick H. Moran, M.B.; Charles F. Strange; John Connell, M.B.; William J. Hill, M.B.

Dated April 7, 1916.—Max H. E. R. Montesole, M.B.; John W. Heekes; William F. Abbott; Frederick A. Hort, M.D.; Ian Campbell; John Brown, M.D.; Charles A. Farrell; Edward C. Wallace; Robert M. Clarke, M.B.; Henry H. Clarke, M.D.; Hugh M. Meyrick-Jones, M.D.; Ernest E. Isaac; Cuthbert J. Nicholson; Frederick T. D. Clindening; Ninian McI. Falkiner, M.D.; James W. Bennett; Roger L. Williams; Thomas D. Jago; Cecil H. Hopwood, M.B.; Arthur J. H. Boyton; Charles B. Dobell, M.D.; Harry Crichton, M.D.; Thomas Fearnhead; Charles L. Chalk; Frank L. Underwood; Everard M. le P. Power; George B. Brown, M.B.; Lanchlan Rose, M.D.; William Kirk, M.D,; Thomas P. Gray, M.D.; John R. H. Ross, M.B.; John M. Twentyman, M.B.; Marshall Hall; Alfred E. Carsberg, M.D.; George H. S. Letchworth; Claude E. W. Wilmot, M.B.; Harold A. Upward, M.B.

Dated April 8, 1916.—Cuthbert J. Butler; Benjamin Sweeten, M.B.; Cyril H. T. Ilott, M.B.; Ernest V. Hunter; John B. Mason, M.B.; Henry H. K. Sparrow; William Leggett, M.D.; John T. Hurst, M.B.; Benjamin B. Ferrar; Robert Buchanan, M.B.; William W. Banham; Robert S. Dewar, M.B.; George M. Elliott, M.B.; Alexander C. Profeit, M.D.; Isaac A. Davidson, M.D.; Norman G. W. Davidson, F.R.C.S.

Dated April 9, 1916.—William Macdonald, M.D.; Alexander H. D. Smith.

Dated April 10, 1916.—William E. Cooke, M.D.; William H. Hooton; Finlay S. Campbell, M.D.; Andrew A. Rutherford, M.B.; Daniel McK. Reid, M.D.; Henry H. Robinson; Hugh T. Prince; Augustus W. Tabuteau, F.R.C.S.I.; Cyril W. Jenner; John H. Mason, M.B.; William W. Dickson, M.B.; Andrew L. E. F. Coleman, M.B.; Ralph C. Fuller; George F. Holt.

Dated April 12, 1916.—Redcliffe N. Salaman, M.D.; John T. McConkey; Charles A. W. Pope, M.B.; Wallace T. Hedley, M.B.; Thomas Strain, M.D.; Andrew G. R. Ritchie, M.B.; George A. Simpson; Daniel Cowin, M.B.; William S. Langworthy; Michael T. MacMahon, M.B.; Charles F. White, M.B.

Dated April 13, 1916.—Robert Richards; William C. Gavin, M.B.; John M. Pooley; Edmund W. Lynch.

Dated April 14, 1916.—Walter Salisbury, M.B.; Herbert J. Hickin, M.B.; Victor H. Mason, M.B.; Henry E. O'Brien; Neil Campbell, M.B.; Percy H. Delamere; Arthur H. Priestley, M.B.; James R. Robertson; John H. Moir, M.D.; Alexander M. Cowie, M.B.; Lindsay W. Batten; Alfred D. Bigland, M.D.; Harold R. Dew, M.B.; Robert K. Birnie, M.B.; Jack Morlet, M.B.; Albert Weigall, M.B.; George C. Scantlebury, M.B.; James G. Sleeman, M.B.; William A. L. H. Henderson, M.B.; Albert W. Bretherton, M.B.; Thomas E. George, M.B.; William A. Bowman, M.B.; William A. H. Birrell, M.B.; William Rogerson, M.B.; Wilberforce S. Newton, M.B.; George C. Bury, M.B.; Nigel L. Prichard, M.B.

Dated April 15, 1916.—Guy B. Courtney, M.D.; Robert McC. Service, M.D.; John Porter, M.B.; Frederick J. Pierce; Robert J. Merson, M.B.; Frederick W. S. Stone; Langford G. Davies, M.B.; Thomas S. McIntosh, M.D.; John C. Sale; Thomas D. Kennedy, M.B.: Kerr Simpson, M.B.

Dated April 16, 1916.—John Scott, M.B.

Dated April 17, 1916.—Herbert M. Spoor, M.B.; Herbert F. Nolan; Hugh H. Moffatt; George H. Darlington, M.B.; Frank G. Wrigley, M.D.; James H. Marshall, M.B.; Arthur L. Weakley, M.B., F.R.C.S.Edin.; Victor J. Batteson; Guy S. Goodwin, M.D.

Dated April 19, 1916.—John Rowat, M.D.; James J. Robb, M.D.; Arthur M. Warwick, M.B.; Bertram E. Wright, M.B.; Crawford S. Crichton, M.D.; William G. Hopkins; George S. Applegate; Robert M. Walker; Arthur H. Butcher; Arthur E. Druitt; Richard Kenefick, M.B.; George R. Lipp, M.B.; Tom Stansfield, M.B.; Wilberforce J. J. Arnold, M.B.

Dated April 20, 1916.—William Carnes; Gerald W. Stone; Riccardo Stephens, M.B.; James C. Waithman, M.D.; William R. Etches, M.D.; Frank H. Looney, M.B.; Robert W. Hogg, M.B.; Johnston Hughston, M.B.

Dated April 21, 1916.—William A. Shann, M.B.; Norman Grellier; David Johnston, John W. Turner, M.B.; Thomas Warner, M.D., F.R.C.S.; Walter C. Blackham, M.B.

Dated May 8, 1916.—George Norman, M.B.

The undermentioned to be temporary Lieutenants:—

Dated March 11, 1916.—Benjamin Richard Roberts; Alexander Benjamin Tucker, M.B., F.R.C.S.

Dated March 15, 1916.—Frederick Albert O'Donnell.
Dated March 24, 1916.—Eric John Dyke, M.B.
Dated March 27, 1916.—Frank Wallis Beer.
Dated March 28, 1916.—George Chisholm Waldemar Williams, F.R.C.S.Edin.

Dated April 1, 1916.—Samuel Littlewood, M.B.; James Gillon Ross, M.B.; Francis William Davidson, M.B.; Crispian Stanley-Clarke, M.B.; William Black Anderson, M.B.; Alfred Everson Harrisson, M.B.; Donald Ross, M.B.; Stanley Robson, M.D., F.R.C.S.Edin.; William Murray Thomas; Reginald Thane Taylor; Albert Edward Pinniger, M.B.; Hans Lowry Morrow, M.B.; Joseph Harvey, M.B.; Ward Ward-Smith, M.D., F.R.C.S.; John Robertson Hall, M.B.; James Prain Lowson, M.D.; Patrick Joseph Murray, M.B.; John MacFarlane Donnan, M.B.; Dennys John Drake; Percy Milnes; Robert Ancel Leembruggen; John Frederick Cooke O'Meara, M.B.; Charles George Skinner, M.B.; Arthur Munby Bayne, M.B.; Alexander Thornton Anderson.

Dated April 2, 1916.—William Anderson, M.B.

Dated April 3, 1916.—Rupert Butterworth, M.B.; Archibald Francis Wright, M.B.; John Carson Houston, M.B.; William Forbes Dunlop, M.B.; Thomas Burnett Thomson; William Young Kingston; George Herbert Harding.

Dated April 4, 1916.—Cedric William Aikman, M.B.; Ernest Edward Cunnah.
Dated April 6, 1916.—Archibald McLean Marshall.

Dated April 7, 1916.—Eric Graham Saunders, M.B.; John Neligan, M.B.; Alfred Cleveland Pickett; David James Jackson, M.D.; John Alexander Vlasto, M.B.; John Joseph Walshe; Walter Patey, M.D.; Joe Edward Ashby; John Howard Lechler, M.B.; James Lawson Whatley.

Dated April 8, 1916.—Wilfred Alexander Steen; Frederick Ernest Feilden.
Dated April 9, 1916.—Vernon John Philip Clifford; William Smith Allan, M.B.

Dated April 10, 1916.—Wilfrid Hallow William Condell Carden; Angus Buchanan, M.B.; George Aloysius Francis; Harold Cairns Terry, M.B.; Sidney Hugh Langston Archer; Arthur Frederick Seacome; George Joseph Adams, M.B., F.R.C.S.Edin.

Dated April 11, 1916.—Charles Dundee, M.B.
Dated April 12, 1916.—Edgar Hepworth Alton; Samuel Pool, M.B.
Dated April 13, 1916.—Kenneth Black, F.R.C.S.

Dated April 14, 1916.—Arthur Beeley, M.D.; Charles Gordon Kemp, M.D.; Charles Dainty Hatrick, M.D.; Charles William Dixon, M.B.; Frederick Hampson Simpson, M.D.; Alfred Hayes Smith, M.B.; Frederick Cuthbert Jobson; Charles Cameron, M.B.

Dated April 15, 1916.—Edmund Hudson; Cecil Crees Austen; Alfred Arthur Hill, M.D.; James Monroe, M.B.; Arthur David Millington, M.B.; James Vincent Watson; William Laurence O'Neill, M.B.; Arthur Clement Price, M.B.

Dated April 16, 1916.—David Archibald Chalmers.

Dated April 17, 1916.—James Gray, M.B.; Ronald James Scarr; Ronald Leslie Ferguson, M.D.; Oswald Roy Allison, M.B.; Thomas Milne Bride, M.D.; Albert Ernest Finney, M.D.; Arthur Ernest Rayner, M.D.; Ernest Ethelbert Hughes, M.B., F.R.C.S.; James Law Falconer, M.B., F.R.C.S.; Philip Sydney Green, M.B.; Roland Hereward Titcombe, M.D.; Ferguson Fitton Carr-Harris, M.D.; Edwin Allan Thomas Green; Herbert Montgomery Jackson, M.B.; Thomas Francis Collins; Louis Laurence McKeever; Temporary Honorary Lieutenant Henry Ward Bennett, M.B.

Dated April 18, 1916.—James Douglas Wright; Hugh Collin Davies, M.B.; James Paterson Crawford, M.B.; Alfred Ball, M.D.

Dated April 19, 1916.—Gerald James McGorty, M.B.; Eric Hemingway Shaw, M.B.; Louis Walton, M.B.; Thomas Duff Miller, M.B.

Dated April 29, 1916.—Kenneth Macfarlane Walker, M.B., F.R.C.S.
Dated June 20, 1915.—Henry Collier, M.D.

The undermentioued temporary Honorary Lieutenants to be temporary Honorary Captains:—

Dated May 9, 1916.—Edward H. Hicks, whilst serving with the British Red Cross Society in France; Frederick W. Hamilton, M.B., whilst serving with No. 2 British Red Cross Hospital.

The undermentioned temporary Honorary Lieutenants to be temporary Lieutenants:—

Dated April 5, 1916.—John Edward Carbery Maguire; John Gordon Ackland; William Ronald White-Cooper.

Dated April 7, 1916.—Arthur Tudor Edwards, F.R.C.S.
Dated April 10, 1916.—Stanley Walter Burrell.

The undermentioned to be temporary Honorary Lieutenants:—

Dated March 31, 1915.—Frank Clare Wilkinson, M.B., whilst employed at No. 6 British Red Cross (Liverpool Merchants' (Mobile) Hospital).

Dated April 13, 1916.—Philip Esmond Darrell Pank; George Philip Buckingham Huddy.

Dated April 15, 1916.—Telford David Morgan.

Dated April 25, 1916.—John Charles Neville Harris; Donald Craig Norris.

Dated April 29, 1916.—Edward Eric Lightwood.

Dated May 2, 1916.—Douglas Sherrin Pracy.

Dated April 30, 1916.—Phillip John Dunn, to be temporary Honorary Quartermaster, with the temporary honorary rank of Lieutenant whilst employed with the Welsh Hospital.

TERRITORIAL FORCE.

Highland Divisional Sanitary Section.—Lieutenant A. F. MacBean, M.B., to be Captain, dated April 22, 1916.

Highland Casualty Clearing Station.—Quartermaster and Honorary Lieutenant W. Charles relinquishes his commission on account of ill-health, dated May 12, 1916.

1st *Highland Field Ambulance.*—Robert Grey, M.B., to be Lieutenant, dated May 3, 1916.

Lowland Casualty Clearing Station.—Captain R. B. Carslaw M.B., from 4th Scottish General Hospital, to be Captain, dated December 1, 1915; Captain R. B. Carslaw, M.B., to be temporary Major whilst in command of a Casualty Clearing Station, dated December 1, 1915.

Lowland Divisional Sanitary Section.—Captain H. L. P. Hulbert, M.D., from Divisional Sanitary Officer, South Midland Division, to be Captain, dated May 13, 1916.

2nd *Lowland Field Ambulance.*—Lieutenant J. Angus, M.B., to be Captain, dated July 25, 1915.

1st *Northern General Hospital.*—The transfer of Lieutenant-Colonel W. E. Hume, M.B., to the Northumbrian Casualty Clearing Station, which was announced in the *Gazette* of December 23, 1914, is cancelled. Lieutenant-Colonel W. E. Hume, M.B., is seconded for duty overseas, dated November 5, 1915.

4th *Northern General Hospital.*—The undermentioned Captains to be Majors, dated April 19, 1916: Osmund H. Chapman, M.D.; George A. C. Shipman, M.B.; Beattie McFarland, M.D.

1st *West Riding Field Ambulance.*—The date of appointment of C. S. Brown, M.B., as Lieutenant, is May 31, 1915, and not as announced in the *Gazette* of June 15, 1915. The following announcement is substituted for that which appeared in the *Gazette* of January 19, 1916: Lieutenant C. S. Brown, M.B., to be Captain, dated December 1, 1915.

1st *Eastern General Hospital.*—Captain O. Inchley relinquishes his commission on account of ill-health, dated May 6, 1916.

1st *East Lancashire Field Ambulance.*—Major (temporary Lieutenant-Colonel) W. L. Bentley relinquishes his temporary rank on ceasing to command a Field Ambulance, dated March 22, 1916; Serjeant Harold Hyde, to be Quartermaster, with the honorary rank of Lieutenant, dated May 4, 1916.

East Lancashire Casualty Clearing Station.—The undermentioned Lieutenants to be Captains: W. Briggs, dated April 11, 1916; J. Ramsay, M.D., dated April 12, 1916; T. W. Leighton, M.B., dated April 13, 1916.

1st *West Lancashire Field Ambulance.*—Captain (temporary Major) J. Wood to be Major, dated April 23, 1916; Lieutenant J. St. G. Wilson, to be Captain, dated April 2, 1916; Captain R. Starkey-Smith, from 3rd London General Hospital, to be Captain, dated May 12, 1916.

1st *South Midland Mounted Brigade Field Ambulance.*—Lieutenant A. C. O. Brown, to be Captain, dated April 4, 1916.

South Midland Casualty Clearing Station.—The following announcement is substituted for that which appeared in the *Gazette* of April 7, 1916: Captain E. Whichello, M.B., from 1st South Midland Field Ambulance to be Captain, dated October 16, 1915; Lieutenant C. W. T. Baldwin to be Captain, dated April 13, 1916.

North Midland Casualty Clearing Station.—Lieutenant-Colonel H. H. C. Dent, M.B., from 3rd North Midland Field Ambulance, to be Lieutenant-Colonel, dated February 29, 1916.

North Midland Mounted Brigade Field Ambulance.—Captain L. A. Dingley, M.D., to be temporary Major, whilst in command of a Field Ambulance, dated May 2, 1916.

2nd North Midland Field Ambulance.—Lieutenant J. B. McLean, M.B., to be Captain, dated February 19, 1916.

2nd Welsh Field Ambulance.—Richard Griffith (late Major, 6th Battalion, Royal Welsh Fusiliers) to be Major, dated May 3, 1916; Captain E. L. Anderson, M.B., from Attached to Units other than Medical Units, to be Captain, dated April 8, 1916; Kaye Farquhar Rashell Davison to be Lieutenant, dated May 3, 1916.

3rd Welsh Field Ambulance.—Major J. Evans, M.D., to be temporary Lieutenant-Colonel whilst in command of a Field Ambulance, dated September 22, 1915.

1st East Anglian Field Ambulance.—Staff-Serjeant John Buggy, Royal Army Medical Corps, to be Quartermaster, with the honorary rank of Lieutenant, dated May 11, 1916.

2nd East Anglian Field Ambulance.—Captain William J. Dearden relinquishes his commission on account of ill-health, dated April 28, 1916.

Home Counties Casualty Clearing Station.—Captain W. Scarisbrick, M.B., from 6th London Field Ambulance, to be Captain, dated May 10, 1916; Alexander Wilson, M.D., to be Lieutenant, dated May 6, 1916.

1st *Wessex Field Ambulance.*—Quartermaster and Honorary Lieutenant J. Lewis, from 3rd Wessex Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated May 2, 1916.

3rd Wessex Field Ambulance.—Quartermaster and Honorary Lieutenant F. G. C. Dixon, from 1st Wessex Field Ambulance, to be Quartermaster, with the honorary rank of Lieutenant, dated May 2, 1916.

1st Southern General Hospital.—The announcement of the seconding of Captain H. B. Whitehouse, which appeared in the *Gazette* of March 13, 1916, is cancelled.

2nd Southern General Hospital.—Captain W. S. V. Stock, M.B., F.R.C.S., to be Major, on the permanent personnel, dated May 13, 1916.

3rd Southern General Hospital.—Captain W. J. Foster, F.R.C.S., from Territorial Force Reserve, to be Captain, dated March 16, 1915; Captain W. J. Foster, F.R.C.S., is seconded for duty at Reading War Hospital, dated March 16, 1915; Lieutenant R. Hitchings to be Captain, dated April 12, 1916.

4th Southern General Hospital.—Major Arthur N. Davis resigns his commission on account of ill-health, dated April 29, 1916.

1st South Western Mounted Brigade Field Ambulance.—Captain L. H. Hay, M.B., resigns his commission, dated May 6, 1916.

1st London Field Ambulance.—Lieutenant (temporary Captain) David J. Scott, M.D., to be Captain, dated April 1, 1915.

1st London Sanitary Company.—The undermentioned Lieutenants to be Captains, dated April 11, 1916: W. Buddin, E. W. Gregory.

2nd London Field Ambulance.—Serjeant-Major Frederick William Benjamin Carter to be Quartermaster with honorary rank of Lieutenant and seconded for duty with the 4th Provisional Field Ambulance, dated April 19, 1916.

2nd London General Hospital.—Lieutenant Leslie N. Reece to be Captain, dated April 8,1916.

2nd London Sanitary Company.—George Sampson Elliston to be Lieutenant, dated May 12, 1916.

5th London Field Ambulance.—Captain (temporary Major) N. C. Rutherford, M.B., from 6th London Field Ambulance, to be Captain, dated December 23, 1914. Captain N. C. Rutherford, M.B., to be temporary Major, December 23, 1914.

TERRITORIAL FORCE RESERVE.

Royal Army Medical Corps.

Major G. R. Swinhoe, from 1st South Western Mounted Brigade Field Ambulance to be Major, dated May 6, 1916.

Transport Officer and Honorary Lieutenant Albert J. L. Innes, from 3rd Lowland Field Ambulance, to be Transport Officer with the honorary rank of Lieutenant, dated April 22, 1916.

GENERAL RESERVE OF OFFICERS.

ROYAL ARMY MEDICAL CORPS.

Captain Thomas J. Crean, V.C., D.S.O., to be temporary Major whilst commanding a Field Ambulance, dated February 26, 1916.

SPECIAL RESERVE OF OFFICERS.

ROYAL ARMY MEDICAL CORPS.

Major Henry G. Smeeth, M.D., to be temporary Lieutenant-Colonel whilst commanding a Field Ambulance, dated January 25, 1916.

Cadet Lance-Corporal Donald Hugh Paterson, M.B., Edinburgh University Officers Training Corps, to be Lieutenant (on probation), dated April 6, 1916.

Lieutenant Owen D. Price, M.B., to be Captain, dated April 7, 1916.

Ex-Cadet Serjeant Humphrey Silvester Evans, Cambridge University Contingent Officers Training Corps, to be Lieutenant (on probation) dated April 20, 1916.

Captain Ronald G. J. McEntire, M.B., resigns his commission on account of ill-health, dated May 2, 1916.

ATTACHED TO UNITS OTHER THAN MEDICAL UNITS.

Captain (temporary Major) Matthew B. Ray, M.D., to be Major, dated December 15, 1914.

Surgeon-Captain John Owen, from Lancashire (Fortress) Engineers, to be Captain, dated April 28, 1916.

Lieutenant Sydney O. Bingham, to be Captain, dated August 22, 1915.

Lieutenant Francis F. C. Jagger, M.B., to be Captain, dated February 28, 1916.

Lieutenant G. Johnston, M.B., to be Captain, dated March 24, 1916.

Lieutenant G. H. Rains, to be Captain, dated March 27, 1916.

Lieutenant J. Muir, M.B., to be Captain, dated April 1, 1916.

Lieutenant W. H. Buckley, to be Captain, dated April 15, 1916.

Lieutenant F. R. H. Laverick, to be Captain, dated April 17, 1916.

Lieutenant A. C. O. Brown, from 1st South Midland Mounted Brigade Field Ambulance, to be Lieutenant, dated May 2, 1916.

John Roderick Bulman, M.B., to be Lieutenant, dated May 6, 1916.

Theodore Llewellyn Fennell, M.B. (late Major, 5th Battalion, Cheshire Regiment), to be Major, dated May 9, 1916.

Lieutenant P. A. Chillcott relinquishes his commission on account of ill-health, dated May 10, 1916.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

THE Annual General Meeting of subscribers to this Society will be held in the Library of the Royal Army Medical College on Monday, June 19, 1916, at about 3.15, following that of the Royal Army Medical Corps Officers' Benevolent Society.

3, *Homefield Road*, *Wimbledon*.

J. T. CLAPHAM, *Captain, Hon. Sec.*

ROYAL ARMY MEDICAL CORPS FUND AND ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

NOTICE OF ALTERATION OF THE DATE OF THE ANNUAL GENERAL MEETINGS OF THE ABOVE FUND AND SOCIETY.

As Monday in Ascot week, June 12, the day fixed for the Annual General Meetings of the above Fund and Society falls this year on Whit Monday, it has been decided to hold the Annual Meetings on the following Monday, June 19, at 2.30 p.m. and 3 p.m. respectively, in the Library of the Royal Army Medical Corps College, Grosvenor Road, S.W.

F. W. H. DAVIE HARRIS, *Lieutenant-Colonel, Secretary.*

124, *Victoria Street, S.W.*

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

Dr. CASH STATEMENT FOR THE YEAR ENDING FEBRUARY 29, 1916. **Cr.**

Receipts.

		£ s. d.
1915 Mar. 1.	To Balance of Cash brought forward from 1914-1915	578 4 2
	,, Subscriptions	451 15 3
	,, Interest on Deposit	9 19 9
	,, Withdrawn from Deposit	400 0 0
		£1,439 19 2

Expenditure.

		£ s. d.	£ s. d.
1915	By Grants to Messes: London	250 0 0	
	Lucknow	50 0 0	300 0 0
	,, Subscribers joining Contributions to Messes		7 6 8
	,, Refund of Subscriptions overpaid		1 17 3
	,, Audit Fee		3 3 0
	,, Printing	0 12 0	
	,, Typing	0 7 0	
	,, Stamps	0 9 9	
	,, Cheque-book	0 4 2	1 12 11
	,, Placed on Deposit		200 0 0
	,, Purchase of 5 per cent. Exchequer Bonds		400 0 0
1916 Feb. 29.	Balance of Cash carried forward to 1916-17		525 19 4
			£1,439 19 2

BALANCE SHEET AT FEBRUARY 29, 1916.

Liabilities.

	£ s. d.
Grant approved to Peshawar Mess	50 0 0
Balance	935 19 4
	£985 19 4

Assets.

	£ s. d.
Five per cent. Exchequer Bonds (at cost price)	400 0 0
Balance outstanding of Loan to Aldershot Mess Committee	60 0 0
Cash at Bankers	525 19 4
	£985 19 4

Audited and found correct
(Signed) EDMOND T. GANN.

(Signed) J. T. CLAPHAM, *Captain*,
Hon. Secretary.

DEATH.

CHESTER.—On May 5, at Coney Gree, Uphatherly, Cheltenham, Colonel William Litchfield Chester, A.M.S. (retired), aged 65, son of the late Rev. Richard Chester, Rector of Middleton, Co. Cork.

HUME-SPRY.—Surgeon-Major George Frederick Hume-Spry, 2nd Life Guards, died at 6, Derwent Road, Eastbourne, on May 13, 1916.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels, and Proceedings of the United Services Medical Society.

Any demand for excerpts, additional to the above, or for reprints, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of **EXCERPTS** *	Extra for Covers for Reprints			
				As Journal, Printed on Front	As Journal, Plain, Unprinted	Cheaper Paper, Printed on Front	Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2	4 3	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 1s. 8d. net; binding, 1s. 6d.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 15 per cent. increase.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W.

Communications have been received from Colonels R. H. Firth, B. Skinner, Lieutenant-Colonels L. W. Harrison, J. H. Neil, W. J. Watt, A. Balfour, M. H. Gordon, Majors A. Don, A. J. Hull, F. M. R. Walshe, R. Draper, V. Nesfield, I.M.S., R. C. Wilson, E. C. Whitehead, Captains A. C. Alport, J. Dale, A. Brown Kelly, W. F. M. Loughnan, H. C. Lucey, J. B. Fisher, T. Strethill Wright, T. G. Moorhead, G. D. Harding, H. F. Wolfenden, S. Smith, M. D. Eder, Lieutenants F. Savy, E. H. Walker, H. E. Brown, J. Cropper, N. F. Lock, W. d'Este Emery, Esq., R. H. Makgill, Esq., H. R. Dean, Esq., R. S. Adamson, Esq., R. Eager, Esq., Professor J. M. Beattie.

The following publications have been received:—

British: The Edinburgh Review or Critical Journal, The Hospital, The Lancet, Proceedings of the Royal Society of Medicine, The Practitioner, The Medical Journal of Australia, The Indian Medical Gazette, The Medical Journal of South Africa, The Royal Engineers' Journal, Journal of the United Service Institution of India, The Middlesex Hospital Journal, St. Bartholomew's Hospital Journal, Guy's Hospital Gazette, The Medical Review, Public Health, Medical Press and Circular, The Army Service Corps Journal, Journal of Tropical Medicine and Hygiene, Red Cross and Ambulance News, Annual Report on the Health of Gibraltar, The Journal of State Medicine, South African Medical Review, Annals of Tropical Medicine and Parasitology, Tropical Diseases Bulletin.

Foreign: Norsk Tidsskrift fur Militaermedicin, Archives de Médecine et de Pharmacie Militaires, Bulletin de l'Institut Pasteur, Russian Naval Medical Journal, International Military Digest Quarterly, Annual Report of the Surgeon General of the Public Health Service of the United States, Bulletin de la Société de Pathologie Exotique, The Military Surgeon, Revista de Sanidád Militar, Proceedings of the Medical Association of the Isthmian Canal Zone, for the half year, October 1914, to March, 1915, vol. vii, part 2, *Giornale di Medicina Militare, Le Caducée, Archives de l'Institut Pasteur de Tunis, l'Ospedale Maggiore, The Journal of Infectious Diseases.*

MANAGER'S NOTICES.

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The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

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Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

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